UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

June 24, 2003

Lawrence C. Evans
Portland District, U.S. Army Corps of Engineers
PO Box 2946
Portland, OR 97208

RE: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Act Essential Fish Habitat Consultation, Juvenile Fish Screen Modifications and Leaburg Tailrace Barrier, Lane County, Oregon (Corps 404 Permit Nos. 200300171/200300172; NOAA Fisheries Consultation No. 2003/00761).

Dear Mr. Evans:

Enclosed is a biological opinion prepared by the National Marine Fisheries Service (NOAA Fisheries), pursuant to Section 7 of the Endangered Species Act (ESA), for the modification of an existing fish screen within the Leaburg Canal and construction of a tailrace barrier at the terminus of Leaburg Canal. The Leaburg Hydroelectric Project is located on the McKenzie River, in Lane County, approximately 20 miles east of the Eugene/Springfield, Oregon metropolitan area.

NOAA Fisheries concludes that the proposed action is not likely to jeopardize Upper Willamette River chinook salmon. Pursuant to Section 7 of the ESA, NOAA Fisheries has included reasonable and prudent measures, and non-discretionary terms and conditions, that are necessary and appropriate to minimize the potential for incidental take associated with this project. Included in the ESA biological opinion is a consultation on the effects of the proposed action on Essential Fish Habitat, pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and its implementing regulations (50 CFR Part 600).

Questions regarding this letter should be directed to Melissa Jundt of my staff at 503-231-2187.

Sincerely,

Brian J. Brown
for D. Robert Lohn
Regional Administrator

cc: Laurie Power, Tim Downey, EWEB
Ann Gray, USFWS
Will Beidler, ODFW
Robert Jossis, MWH

Endangered Species Act
Section 7 Consultation

Biological Opinion

and

Magnuson-Stevens Fishery Conservation and Management Act Consultation

on the Effects of Construction of Leaburg Tailrace Barrier and Modification of Leaburg Fish Screens, in the McKenzie River Subbasin, on Upper Willamette River Chinook Salmon

Action Agency:	US Army Corps of Engineers
Consultation Conducted By:	NOAA Fisheries Northwest Region Hydropower Division
NOAA Fisheries Log Number:	F/NWR/2003/00761
Date Issued:	June 24, 2003

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1. ENDANGERED SPECIES ACT

1.1 Background

By letter dated May 29, 2003, the U.S. Army Corps of Engineers (USACE) requested initiation of Endangered Species Act (ESA) Section 7 consultation with National Marine Fisheries Service (NOAA Fisheries) for the construction of a fish exclusion barrier (tailrace barrier) at the terminus of Leaburg Tailrace and modifications to the existing fish screen, located within the Leaburg Canal. The Leaburg Hydroelectric Project is located on the McKenzie River in Lane County, approximately 20 miles east of the Eugene/Springfield, Oregon, metropolitan area. The biological assessment provided by EWEB (2003), with the request for consultation, determined that the proposed activities would be likely to adversely affect Upper Willamette River (UWR) chinook, which are listed under the ESA. The objective of this biological opinion is to determine whether the proposed action is likely to jeopardize the continued existence of this species.

The Willamette River supports UWR chinook salmon (*Oncorhynchus tshawytscha*). UWR chinook were listed as threatened under the ESA by NOAA Fisheries on March 24, 1999 (64 FR 14308). Subsequently, protective regulations were issued under Section 4(d) of the ESA on July 10, 2000 (65 FR 42422). Additionally, NOAA Fisheries designated critical habitat for this species on February 16, 2000 (65 FR 7764), and withdrew the designation by consent decree on April 30, 2002.

1.1.1 Consultation History

On September 6, 2001, the U.S. Fish and Wildlife Service and NOAA Fisheries (the Services) issued a joint biological opinion on the operation of the Leaburg-Walterville Hydroelectric Project, under the 1997 FERC license, as reinstated and amended by FERC order dated April 27, 2000; the conservation measures as proposed in the biological assessment submitted by FERC; and the revised and updated license articles developed by NOAA Fisheries, USFWS, EWEB, and FERC separated staff. On December 18, 2001, FERC issued a new license to EWEB. This license included many measures to protect fish within the McKenzie River.

The September 6, 2001, biological opinion acknowledged that the construction of the fish passage facilities would affect the listed resources. Based on the information available in the biological assessment, NOAA Fisheries concluded that construction of the Leaburg tailrace barrier and fish screen modifications would not jeopardize listed species. Incidental take terms and conditions 6.a-f were included with the biological opinion to minimize take associated with construction, based on the description of construction activities available at the time. However, the biological opinion acknowledged that the design of the fish facilities would be described by the applicant in greater detail in the future. Specifically, the biological opinion stated that, "Whereas this proposed action includes construction activities, the effects of which are taken into account in this biological opinion, the details of that construction have not been developed in sufficient detail and will be the subject of further consultation with the USACE."

On May 10, 2002, and June 21, 2002, NOAA Fisheries completed biological opinions on the construction of a new fish ladder and modification to an existing fish ladder at the Leaburg Project (May 10) and construction of fish screens and a tailrace barrier at the Walterville Project (June 21).

EWEB provided NOAA Fisheries the opportunity to review and comment on the project design. The currently proposed design has been reviewed by NOAA Fisheries and approved by letter (NOAA Fisheries 2003).

The proposed construction of the tailrace barrier and modification to the existing fish screens at the Leaburg Project prompted a need for a Section 404 permit from USACE. The USACE's proposed issuance of a 404 permit for construction activities at the Leaburg tailrace is the subject of this ESA Section 7(a)(2), formal consultation, between NOAA Fisheries and USACE. A biological assessment was developed by EWEB (2003). The May 29, 2003, request for initiation of consultation stated that USACE adopts this biological assessment for the project.

1.1.1.1 Project History and Description

EWEB owns and operates the Leaburg-Walterville Hydroelectric Project, which is located on the McKenzie River approximately 20 miles east of the Eugene/Springfield metropolitan area. Figure 1 provides a map of the McKenzie River subbasin, showing the location of the Leaburg-Walterville Hydroelectric Project. The Leaburg-Walterville Hydroelectric Project is a FERC-licensed project and operates under the terms of that license. The Leaburg-Walterville Hydroelectric Project operates under a single FERC license, but the project consists of two separate hydroelectric producing facilities, the Leaburg and Walterville developments. The work proposed will be completed entirely at the Leaburg development.

The Leaburg Dam and powerhouse are approximately 28 and 23 miles, respectively, east of the Eugene/Springfield metropolitan area. The Leaburg development was completed in 1930 and consists of a dam, a 5-mi-long, 15-ft deep unlined canal (Leaburg Canal), forebay, penstocks, powerhouse, tailrace, and substation. Leaburg Dam is a reinforced concrete and steel structure approximately 400 ft long and 22 ft high. The dam is equipped with three 100-ft by 9-ft rollgates, a sluice way, and intake gates that divert water from the McKenzie River. The impounded area behind the Leaburg Dam (Leaburg Lake) extends about 1.5 mi upstream and covers an area of about 57 acres. Water diverted at the dam for power generation passes through a downstream migrant fish screen facility and enters the Leaburg Canal leading to the Leaburg forebay and powerhouse. The downstream migrant fish screen structure is located near the head end of the canal and consists of three steel V-shaped screen bays.

To be compliant with the terms of the FERC license and the September 6, 2001, Leaburg-Walterville Biological Opinion Incidental Take Statement (ITS), EWEB must construct an adult barrier (FERC license article 416) at the terminus of Leaburg tailrace in accordance with a facilities plan referencing the concepts identified in the NMFS' working Technical Paper entitled "The Use of Barriers to Prevent Adult Salmon Delay and Injury at Hydroelectric Powerhouses and Wasteways," dated November 19, 1993. The FERC license articles include the following measures to minimize the adverse effects on UWR chinook salmon of the construction and operation of the Leaburg Tailrace Barrier: 1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401 and ITS 6.a); 2) EWEB must plan in-water construction activities, including construction of the Leaburg Tailrace Barrier, to avoid sensitive times of the year, such as migration periods (Article 403 and ITS 6.b); 3) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with the tailrace barrier that may be detrimental to aquatic resources (Article 424 and ITS 6.e); and 4) EWEB must provide yearly compliance reports on the operation and maintenance of all physical structures. The FERC license and the ITS also require EWEB consult with the Services (U.S. Fish and Wildlife and NOAA Fisheries) during design of the facilities, notify the Services 90 days before and after completion of construction, and consult with the Services on any modifications of project facilities.

The second activity proposed, which is also a requirement of the FERC license (Article 416 and ITS 2.a), includes modification of the Leaburg fish screen. The proposed modifications include the construction of additional screens, new concrete wing walls, relocation of existing pumps and piping, and regrading the right bank of the Leaburg Canal. A temporary water supply will be provided which is intended to provide flow for fish within the canal downstream of the screens (resident fish) and for water to the fish hatchery. A cofferdam is proposed to be constructed to allow dewatering of the site during construction, and the canal entrance gates would be closed. Discharge and runoff water would be managed according to EWEB's proposed conservation measures. The same additional FERC license requirements apply to the construction of the fish screen modifications, including: 1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401 and ITS 6.a); 2) EWEB must plan in-water construction activities, including construction of the Leaburg Tailrace Barrier, to avoid sensitive times of the year, such as migration periods (Article 403 and ITS 6.b); 3) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with the tailrace barrier that may be detrimental to aquatic resources (Article 424 and ITS 6.e); and 4) EWEB must provide yearly compliance reports on the operation and maintenance of all physical structures. The FERC license and the ITS also require EWEB consult with the Services (U.S.

Fish and Wildlife and NOAA Fisheries) during design of the facilities, notify the Services 90 days before and after completion of construction, and consult with the Services on any modifications of project facilities.

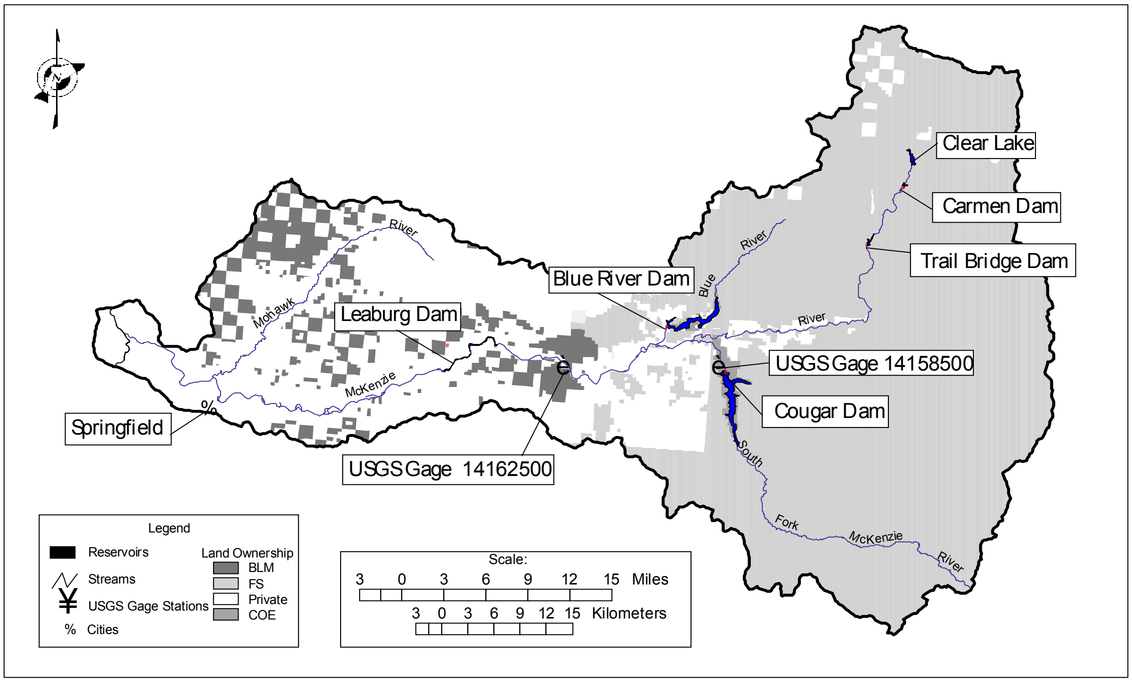

Figure 1. The McKenzie River subbasin, showing locations of EWEB and USACE projects.

1.2 Proposed Action and Action Area

1.2.1 Project Description

The proposed action in this biological opinion is the issuance of a 404 permit for dredge and fill activities associated with the construction of the Leaburg Tailrace Barrier and fish screen modifications. EWEB and USACE propose that this project include construction and removal of cofferdams, construction of the tailrace barrier, modification to the existing Leaburg fish screens (including new concrete wing walls, relocation of existing pumps and piping, and regrading the right bank of Leaburg Canal), and dewatering of portions of Leaburg Canal. The USACE 404 permit is expected to authorize all of these activities described in the biological assessment (EWEB 2003).

The Leaburg Tailrace Barrier will be a 250-ft wide structure placed at the confluence of the powerhouse tailrace and the McKenzie River. The design is based upon a design criterion of 1.35-ft/second water velocity through the barrier, and a maximum of 1-inch spacing between barrier pickets. These design criteria are consistent with the proposed design that have been reviewed and approved in NOAA Fisheries 2003. The barrier structure will be 14.5 ft tall from the bottom of the canal to the top of the deck. It will have a concrete slab at the canal bottom and concrete abutment walls at each canal bank. The structure will be made of steel beams with steel grating on the deck. Atop the deck will sit a mechanical, non-automated trash rake. The raking machine will run the length of the barrier on railroad track-style rails. The electric powered, hydraulic-actuated trash rake will be used to clear debris from the upstream side of the screen and deposit debris into an attached cart. The machine will also raise and lower the 20.5-ft by 5-ft barrier sections. The barrier is proposed to be out of service for 6 months of the year when UWR chinook salmon adults are not migrating upstream. The facilities plans, including this proposed operation, were submitted by EWEB to NOAA Fisheries for review and approval (per ITS 2.a.6). NOAA Fisheries concurred with this plan (NOAA Fisheries 2003). The barrier sections will be pivoted at the bottom and have movable anchor devices at the top. The trash rake will raise and lower these sections using a cable that is permanently attached to the barrier sections. When the barriers are down, the end of the cable will be anchored to the deck for storage. When the barriers are in place, the cables will be stored on the deck or removed.

The existing fish screens in the Leaburg Canal were constructed in 1983. The screens are located near the head end of the Leaburg Canal and consist of three steel, V-shaped screen bays. The screens are operated year-round to allow safe passage past the dam for anadromous fish that are migrating downstream.

The Leaburg screen modifications will consist of constructing additional screens upstream of the existing V-shaped screen bays. The modifications will be designed to accommodate the future Leaburg Lake raise and will reduce the headloss through the fish screens to approximately 0.70 ft. The design is based on NOAA Fisheries' requirements for maximum screen velocities of 0.4

fps (NMFS 1995). Concrete wing walls will be constructed upstream of the existing fish screens on each side of the Leaburg Canal. Within each of these wing walls, five 13-ft high screen panels will be mounted vertically between galvanized steel support columns. The screen structures on each side of the canal will be 15.4 ft tall from the concrete slab at the base of the screens to the top of the deck. Grating will be provided across the top of the fish screen structures.

Fish screen cleaning will be performed by an automated, carriage-mounted, brush-type cleaner. Each of the new fish screens will have a cleaning system. The carriage traverses the length of the fish screens on a rail system mounted to steel framing. The brush assembly will have a 5-ft long brush, and will require three passes to clean the entire height of the screens. The total time for completing a cleaning cycle will be about four minutes.

Modifications to the existing V-shaped screen bays will include relocation of pumps and piping, reduction of the opening size from 6 to 3 inches on the existing trashracks, and regrading the right bank of the Leaburg Canal. The bypass entrances also will be modified with chimney enclosures with hinged diffuser plates for improved inspection and cleaning. The existing pedestrian bridge across the Leaburg Canal also will be replaced with a new bridge located downstream of the existing fish screens. The bridge will be 6 ft wide and supported with concrete spread footings.

Table 1. Proposed construction schedule.

Leaburg Screen and Bypass Modifications		
Task	**Start**	**Finish**
EWEB Issue Notice to Proceed	03/12/03	03/12/03
Contractor Outage Preparations	05/06/03	06/29/03
EWEB Dewater/Fish Salvage	06/30/03	07/11/03
Contractor Construct Outage Work	07/11/03	11/28/03
Startup and Testing	12/01/03	12/05/03
Remove Cofferdam and Temporary Water Supply	12/08/03	12/08/03
Outage Ends	12/22/03	12/22/03
Screen Project Complete	01/30/04	01/30/04

Leaburg Tailrace Barrier		
Task	**Start**	**Finish**
EWEB Issue Notice to Proceed	04/21/03	04/21/03
Prep for In-River Work	04/21/03	06/30/03
Place Tailrace Coffer Dam	06/30/03	07/04/03
EWEB Dewater/Fish Salvage	07/07/03	07/11/03
In-River Work	07/14/03	12/05/03
Remove Coffer Dam	12/08/03	12/12/03
Outage Ends	12/22/03	12/22/03
Contractor Complete Post Outage Work	12/22/03	12/26/03
Leaburg Tailrace Barrier Project Complete	01/09/04	01/09/04

The method of construction will be to work in the dry behind a cofferdam, which will isolate the work area from the McKenzie River. The cofferdam is proposed to be constructed of rock in a similar fashion as the cofferdam used for the Walterville Tailrace Barrier construction method. Best management practices such as using silt fence, straw bales, and jute matting, will be used to minimize erosion and sedimentation during construction. General construction equipment such as dump trucks, excavators, and cranes will be used to construct the tailrace barrier. All equipment and machinery will be maintained to prevent toxic chemical runoff, as detailed in the Proposed Conservation Measures section of this report. Once construction is complete, temporarily disturbed areas will be stabilized and revegetated and monitored for success as detailed in the Proposed Conservation Measures (Section 1.2.2).

Creation of new access roads for construction of each facility has been minimized. The west side of Leaburg fish screens will be accessed from Highway 126 into an existing graveled parking lot (adjacent to the west side of the fishscreen structure). The east side of the fish screens will be accessed from an existing county road and EWEB canal roads. The tailrace barrier will be accessed (both on the east and west sides) from Highway 126 through an existing housing area, which is already graveled. Access to the west side of the tailrace through a temporary access road, which will be reseeded and replanted following construction. The east side of the tailrace will be accessed through a new permanent access road (lengthening the existing road by 250 feet).

In a June 12, 2003, e-mail sent by Robert Jossis (Montgomery Watson Harza) on behalf of EWEB, EWEB proposes to modify the proposed cofferdam method. A Portadam will be installed at the confluence of the McKenzie River and Leaburg Tailrace to isolate the construction area from the river. An additional smaller Portadam will be installed within the tailrace, upstream of the construction area, to isolate the area from upstream seepage/inflow. A rock-fill cofferdam is still planned to isolate the construction area at the screens.

1.2.2 Proposed Conservation Measures

To avoid, minimize, and mitigate for the construction related impacts, EWEB and USACE propose the following measures:

a. Project design. EWEB and USACE will avoid, minimize, and mitigate impacts to natural resources from construction activities. The following overall project design conditions will be met.
   i. Minimum area. Construction impacts will be confined to the minimum area necessary to complete the project.
   ii. In-water work. Wherever possible, work within the active channel of all anadromous fish-bearing streams, or in systems, which could potentially contribute, sediment, or toxicants to downstream fish-bearing systems, will be completed within the Oregon Department of Fish and Wildlife (ODFW) approved in-water work period (ODFW 2000). Due to the length of time necessary to complete some of the facilities, some in-water construction will occur outside the in-water work guidelines, based on the schedule in Appendix A of the joint biological opinion (Appendix C) that was developed in consultation with ODFW specifically for construction at the Leaburg and Walterville projects and which was approved previously by NOAA Fisheries, USFWS, and FERC.
      (1) Work period extensions. If EWEB needs to extend the in-water work period from those identified in Attachment A of the joint biological opinion (Appendix C), including those for work outside the wetted perimeter of the stream, but below the ordinary high-water mark, the extensions must be approved by biologists from the Services.
      (2) Isolation of in-water work area. During in-water work, if listed fish may be present, including incubating eggs or juveniles, and the project involves either significant channel disturbance or use of equipment instream, EWEB will ensure that the work area is well isolated from the active flowing stream within a cofferdam (made out of sandbags, sheet pilings, inflatable bags, gravel berm, etc.), or similar structure, to minimize the potential for sediment entrainment. Furthermore, no ground or substrate disturbing

action will occur within the active channel 300 ft upstream of potential spawning habitat as measured at the thalweg without isolation of the work area from flowing waters.

(a) Fish screen. Any water intake structure authorized under a biological opinion issued by the Services must have a fish screen installed, operated, and maintained in accordance to NOAA Fisheries (NMFS 1995, NMFS 1996) fish screen criteria.

(b) Seine and release. Prior to and intermittently during pumping, EWEB will attempt to seine and release fish from the work isolation area as is prudent to minimize risk of injury.

(i) Seining will be conducted by or under the supervision of EWEB's fishery biologist and all staff working with the seining operation will have the necessary knowledge, skills, and abilities to ensure the safe handling of all ESA-listed fish.

(ii) ESA-listed fish will be handled with extreme care and kept in water to the maximum extent possible during seining and transfer procedures. Any transfer of ESA-listed fish will be conducted using a sanctuary net that holds water during transfer, whenever necessary to prevent the added stress of an out-of-water transfer.

(iii) Seined fish will be released as near as possible to capture sites.

(iv) If EWEB transfers any ESA-listed fish to third parties other than the Services personnel, EWEB will secure written approval from the Services.

(v) EWEB will obtain any other Federal, state, and local permits and authorizations necessary for the conduct of the seining activities.

(vi) EWEB will allow the Services or their designated representatives to accompany field personnel during the seining activity, and allow such representative to inspect EWEB's seining records and facilities.

(vii) A description of any seine and release effort will be included in a post-project report, as described below under measure g.ii.

(b) Sediment-laden or contaminated water pumped from the work isolation area will be discharged into an upland area where practicable providing over-ground flow prior to returning to the canal or river. Discharge will occur in such a manner as not to cause erosion. For areas where no upland area is present, EWEB will assure the discharge is filtered prior to being returned to the river and that filtered material is not released back to the river upon removal. EWEB will not discharge into potential fish spawning areas or areas with submerged vegetation.

iii. Fish passage. Work will not inhibit passage of any adult or juvenile salmonid species throughout the construction period or after project completion. All culvert and road designs will comply with ODFW guidelines and criteria for stream-road crossings (ODFW 1999a) with appropriate grade controls to prevent culvert failure due to changes in stream elevation. EWEB's construction activities will not modify channels that could adversely affect fish passage, such as by increasing water velocities.

iv. Pollution and Erosion Control Plan. A Pollution and Erosion Control Plan (PECP) will be developed for each authorized project to prevent point-source pollution related to construction operations. For the Leaburg and Walterville construction activities, EWEB is required to develop and submit for FERC approval a PECP for construction and operation as described in License Article 401. The PECP in this proposed action is proposed to be identical to the PECP implemented in 2002 for the work at the Walterville hydroelectric project. In addition to meeting the license article requirements, EWEB ensures the PECP will contain the pertinent elements listed below and meet requirements of all applicable laws and regulations:

(1) Methods that will be used to prevent erosion and sedimentation associated with access roads, stream crossings, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations and staging areas.

(2) Methods that will be used to confine and remove and dispose of excess concrete, cement and other mortars or bonding agents, including measures for washout facilities.

(3) A description of the hazardous products or materials that will be used, including inventory, storage, handling, and monitoring.

(4) A Spill Containment and Control Plan with notification procedures, specific clean up and disposal instructions for different products, quick response containment, and clean-up measures that will be available on site, proposed methods for disposal of spilled materials, and employee training for spill containment.

(5) Measures that will be taken to prevent construction debris from falling into any aquatic habitat. Any material that falls into a stream during construction operations will be removed in a manner that has a minimum impact on the streambed and water quality.

v. Temporary access roads. EWEB will design temporary access roads as follows:

(6) Existing roadways or travel paths will be used whenever reasonable.

(7) A helicopter survey conducted with ODFW during the 2001 spawning season located spawning habitat. Where stream crossings are essential, EWEB will avoid any spawning habitat within 1,000 ft upstream and downstream.

(8) No stream crossings will occur at known or suspected spawning areas or within 300 ft upstream of such areas where impacts to spawning areas may occur.
(9) Where stream crossings are essential, EWEB's crossing design will accommodate reasonably foreseeable risks (e.g., flooding and associated bedload and debris) to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.
(10) EWEB vehicles and machinery will cross riparian areas and streams at right angles to maintain the main channel wherever reasonable.
(11) EWEB's temporary roads within 150 ft of streams will avoid, minimize, and mitigate soil disturbance and compaction by clearing vegetation to ground level and placing clean gravel over geotextile fabric.
(12) EWEB will minimize the number of stream crossings.

v. Treated wood removal. EWEB will use the following precautions regarding removal of treated wood.
(1) No treated wood debris will fall into the water. If treated wood debris does fall into the water, it will be removed immediately.
(2) All treated wood debris will be disposed of at an approved disposal facility for treated wood.
(3) If treated wood pilings will be removed, EWEB will ensure these conditions are followed:
(a) Pilings to be removed will be dislodged with a vibratory hammer, or other means acceptable to the Services.
(b) Once loose, the pilings will be placed onto the construction barge or other appropriate dry storage location, and not left in the water or piled onto the stream bank.
(c) If pilings break during removal, the remainder of the submerged section will be left in place.
(d) Long- term disposal of the piles must be at an approved disposal area for hazardous materials of this classification.
(e) Projects involving pile removal require long-term monitoring to ensure that if altered currents expose more pile, it must also be removed.

vi. Cessation of work. EWEB will cease all project operations, except efforts to minimize storm or high flow erosion, under high flow conditions that may result in inundation of the project area.

vii. Wastewater filtering. Sediment-laden or contaminated water pumped from the work isolation area will be discharged into an upland area where practicable providing over-ground flow prior to returning to the canal or river. Discharge will occur in such a manner as not to cause erosion. For areas where no upland area is present, e.g., the right bank fish ladder, EWEB will assure the discharge is filtered prior to being returned to the river and that filtered material is not released back to the river upon removal. EWEB will not discharge into potential fish spawning areas or areas with submerged vegetation.

viii. Additional EWEB monitoring. EWEB will have a full-time inspector in the field monitoring construction practices, including compliance with EWEB's Proposed Measures and the PECP. Implementation of the FERC-required Quality Control Inspection Program (QCIP) is designed to ensure environmental compliance quality control. The QCIP requires monthly progress reports regarding quality control of environmental protection measures, including the following: discussion of erosion control and other measures and their effectiveness, discussion of any instances where sediments or other construction discharges entered the stream, the extent of the discharges, an assessment of any damage to the stream, and corrective actions taken, including measures to prevent further problems. EWEB will also perform periodic, random site visits throughout the work period, accompanying the full-time inspector on site inspections and ensuring thorough inspection and enforcement of environmental measures. EWEB will send email summary reports of these visits to NOAA Fisheries.

b. Pre-construction activities. EWEB will undertake the following actions prior to significant alteration of the action area.

i. Boundaries of the clearing limits associated with site access and construction will be flagged to prevent ground disturbance of critical riparian vegetation, wetlands, and other sensitive sites beyond the flagged boundary.

ii. The following erosion control materials will be onsite:

(1) A supply of erosion control materials (e.g., silt fence and straw bales) will be on hand to respond to sediment emergencies. Sterile straw or hay bales will be used when available to prevent introduction of weeds.

(2) An oil-absorbing, floating boom will be available on site during all phases of construction whenever surface water is present.

iii. All temporary erosion controls (e.g., straw bales, silt fences) will be in place and appropriately installed downslope of project activities within the riparian area. Effective erosion control measures will be in place at all times during the contract, and will remain and be maintained until such time that permanent erosion control measures are effective.

c. Heavy Equipment. EWEB will restrict use of heavy equipment as follows.

i. When heavy equipment is required, EWEB will use equipment having the least impact (e.g., minimally sized, rubber tired).

ii. Heavy equipment will be fueled, maintained and stored as follows:

(1) All equipment that is used for instream work will be cleaned prior to operations below the bankfull elevation. External oil and grease will be removed, along with dirt and mud. No untreated wash and rinse water will be discharged into streams and rivers without adequate treatment.

(2) Place vehicle staging, maintenance, refueling, and fuel storage areas a minimum of 50 ft horizontal distance from Leaburg Canal and the McKenzie River for construction of Leaburg Tailrace Barrier. The PECP developed under Section a.iv. will prevent point-source pollution of the river.
(3) All vehicles operated within 150 ft of any stream or water body will be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected will be repaired before the vehicle resumes operation.
(4) When not in use, vehicles will be stored in the vehicle staging area.

d. Site preparation. EWEB will prepare the site in the following manner, including removal of stream materials, topsoil, surface vegetation and major root systems.
   i. To the extent practicable, any instream large wood or riparian vegetation that is moved or altered during construction will stay on site or be replaced with a functional equivalent.
   ii. EWEB will minimize clearing and grubbing within 150 ft of any stream occupied by listed salmonids during any part of the year, or within 50 ft of any stream not occupied by listed salmonids.
   iii. Tree removal will be strictly limited.
      (1) All perennial and intermittent streams: Trees (3 inches diameter at breast height or greater) will be removed from within 150 ft horizontal distance of the ordinary high water mark only when necessary for construction of approved facilities. All trees that will be removed will be flagged.
      (2) Tree removal will be mitigated for onsite by a 2:1 replanting ratio.
   iv. Whenever the project area is to be revegetated or restored, EWEB will stockpile native channel material, topsoil, and native vegetation removed for the project for redistribution on the project area.

e. Earthwork. EWEB will complete earthwork, including drilling, blasting, excavation, dredging, filling and compacting, in the following manner:
   i. Boulders, rock, woody materials, and other natural construction materials used for the project will be obtained from outside of the riparian area.
   ii. During excavation, native streambed materials will be stockpiled above the bankfull elevation for later use. If riprap is placed, native materials will be placed over the top of the riprap.
   iii. Material removed during excavation will only be placed in locations where it cannot enter streams or other water bodies.
   iv. All exposed or disturbed areas will be stabilized to prevent erosion.
      (1) Areas of bare soil within 150 ft of waterways, wetlands, or other sensitive areas will be stabilized by native seeding, mulching, and placement of erosion control blankets and mats, if applicable, quickly as reasonable after exposure, but within 7 days of exposure.

(2) All other areas will be stabilized quickly as reasonable, but within 14 days of exposure.

(3) Seeding outside of the growing season will not be considered adequate nor permanent stabilization.

v. All erosion control devices will be inspected during construction to ensure that they are working adequately.

(1) Erosion control devices will be inspected daily during the rainy season, weekly during the dry season, and monthly on inactive sites.

(2) If inspection shows that the erosion controls are ineffective, work crews will be mobilized immediately, during working and off-hours, to make repairs, install replacements, or install additional controls as necessary.

(3) Erosion control measures will be judged ineffective when turbidity plumes are evident in waters occupied by listed salmonids during any part of the year.

vi. If soil erosion and sediment resulting from construction activities is not effectively controlled, EWEB will limit the amount of disturbed area to that which can be adequately controlled.

vii. Sediment will be removed from sediment controls once it has reached one-third of the exposed height of the control. Whenever straw bales are used, they will be staked and dug into the ground 5 inches (12 cm). Catch basins will be maintained so that no more than 6 inches (15 cm) of sediment depth accumulates within traps or sumps.

viii. Sediment-laden water created by construction activity will be filtered before it enters a stream or other water body. Silt fences or other detention methods will be installed as close as reasonable to culvert outlets to reduce the amount of sediment entering aquatic systems.

f. <u>Site restoration</u>. EWEB will restore and clean up the site, including protection of bare earth by seeding, planting, mulching and fertilizing, in the following manner.

i. All damaged areas will be restored to pre-work conditions including restoration of original streambank lines, and contours.

ii. All exposed soil surfaces, including construction access roads and associated staging areas, will be stabilized at finished grade with mulch, native herbaceous seeding, and native woody vegetation prior to October 1. On cut slopes steeper than 1:2, a tackified seed mulch will be used so that the seed does not wash away before germination and rooting occurs. In steep locations, a hydro-mulch will be applied at 1.5 times the normal rate. Disturbed areas will be planted with native vegetation specific to the project vicinity or the region of the state where the project is located, and will comprise a diverse assemblage of woody and herbaceous species.

iii. Plantings will be arranged randomly within the revegetation area.

iv. All plantings will be completed prior to April 15.

v. No herbicide application will occur within 300 ft of any stream channel as part of this permitted action. Undesired vegetation and root nodes will be mechanically removed.

vi. No surface application of fertilizer will be used within 50 ft of any stream channel.

vii. Fencing will be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons.

viii. Plantings will achieve an 80% survival success after three years.

(1) If success standard has not been achieved after 3 years, EWEB will submit an alternative plan to USACE. The alternative plan will address temporal loss of function.

(2) Plant establishment monitoring will continue and plans will be submitted to USACE until site restoration success has been achieved.

g. <u>Monitoring: Construction</u>. Within 30 days of completing the project, EWEB will submit a monitoring report to USACE, Oregon Division of State Lands (ODSL), and the Services describing EWEB's success in carrying out the Proposed Measures to avoid, minimize, and mitigate for construction-related impacts. This report will consist of the following information.

i. <u>Project identification</u>.

(1) Applicant's name.

(2) Project name.

(3) Construction activity.

(4) Compensatory mitigation site(s) (if any) by 5th field HUC and latilong.

(5) Starting and ending dates for work performed.

(6) EWEB's contact person.

ii. <u>Isolation of in-water work area</u>. All projects involving isolation of in-water work areas will include a report of any seine and release activity including:

(1) The name and address of the supervisory fish biologist.

(2) Methods used to isolate the work area and minimize disturbances to ESA-listed species.

(3) Stream conditions prior to and following placement and removal of barriers.

(4) The means of fish removal.

(5) The number of fish removed by species.

(6) The location and condition of all fish released; and any incidence of observed injury or mortality.

iii. <u>Pollution and erosion control</u>. Copies of all pollution and erosion control inspection reports, including descriptions of any failures experienced with erosion control measures, efforts made to correct them, and a description of any accidental spills of hazardous materials will be submitted.

iv. <u>Treated wood pilings</u>. Any project involving removal of treated wood pilings will include the name and address of the approved disposal area and the plan for long-term monitoring to ensure that if altered currents expose more pile, it will also be removed.

v. Site restoration. Documentation of the following conditions:
   (1) Finished grade slopes and elevations.
   (2) Log and rock structure elevations, orientation, and anchoring, if any.
   (3) Planting composition and density.
   (4) A plan to inspect and, if necessary, replace failed plantings and structures for a period of five years.

vi. A narrative assessment of the project's effects on natural stream function.

vii. Photographic documentation of environmental conditions at the project site and compensatory mitigation site(s) (if any) before, during, and after project completion.
   (1) Photographs will include general project location views and close-ups showing details of the project area and project, including pre- and post-construction.
   (2) Each photograph will be labeled with the date, time, photo point, project name, the name of the photographer, and a comment describing the photograph's subject.
   (3) Relevant habitat conditions include characteristics of channels, streambanks, riparian vegetation, flows, water quality, and other visually discernable environmental conditions at the project area, upstream and downstream of the project.

1.2.3 Description of the Action Area

An action area is defined by NOAA Fisheries regulations (50 CFR 402.02) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." Direct effects occur at the project site and may extend upstream or downstream based on the potential for impairing fish passage, hydraulics, sediment and pollutant discharge, and the extent of riparian habitat modifications. Indirect effects may occur throughout the watershed where actions described in this biological opinion lead to additional activities or affect ecological functions, contributing to habitat degradation. Thus, the action area is defined as that bankline, riparian area, and aquatic habitat affected by the proposed action. For this consultation, the action area, because of the upstream (e.g., recycling of marine-derived nutrients) and downstream effects of the continued operation of the Leaburg-Walterville Project, encompasses the entire McKenzie River subbasin (Figure 1), excluding areas above EWEB's Trail Bridge Dam and USACE's Cougar and Blue River dams in the headwater of the McKenzie, and extending downstream to the confluence with the Willamette River.

1.3 Biological Information

Biological information on UWR chinook salmon may be found in the Status Review of Chinook Salmon from Washington, Oregon, and California (Myers et al. 1998). NOAA Fisheries expects that UWR chinook salmon, native to the McKenzie River subbasin, may be present in the action area during construction.

1.3.1 Upper Willamette River Chinook Salmon

1.3.1.1 Geographic Boundaries and Spatial Distribution

The UWR chinook salmon evolutionarily significant unit (ESU) includes native spring-run populations above Willamette Falls and in the Clackamas River. In the past, it included sizable numbers of spawning salmon in the Santiam River, the Middle Fork Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. Although the total number of fish returning to the Willamette has been relatively high (24,000), about 4,000 fish now spawn naturally in the ESU, of which about two-thirds originate in hatcheries. The McKenzie River probably supports the only remaining population in the ESU that is sustained by natural production (ODFW 1998a).

1.3.1.2 Historical Information

There are no direct estimates of the size of the chinook salmon runs in the Willamette River basin before the 1940s. McKernan and Mattson (1950) present anecdotal information that the Native American fishery at Willamette Falls may have yielded 2,000,000 lb (908,000 kg) of salmon (454,000 fish, each weighing 20 lb [9.08 kg]). Based on egg collections at salmon hatcheries, Mattson (1948) estimates that the spring chinook salmon run in the 1920s may have been five times the run size of 55,000 fish in 1947, or 275,000 fish. Much of the early information on salmon runs in the upper Willamette River basin comes from the operation reports produced by state and Federal hatcheries.

1.3.1.3 Life History

Fish in this ESU are distinct from those of adjacent ESUs in life history and marine distribution (see Section 1.3.1.6). The timing of the spawning migration is limited by Willamette Falls. High flows in the spring allow access to the upper Willamette River basin, whereas low flows in the summer and autumn prevent later-migrating fish from ascending the falls. The low flows have probably served as an isolating mechanism, separating this ESU from others nearby.

UWR chinook salmon have a life history pattern that includes traits from both ocean- and stream-type life histories. The majority of juveniles emigrate as young-of-the-year in late winter/early spring and as age-1 fish in the fall. A relatively small number presently emigrate through the second spring. The ocean distribution of fish from this ESU, most of which are caught off the coasts of British Columbia and Alaska, is consistent with an ocean-type life history. Freshwater entry begins in February, the earliest return timing of chinook stocks in the Columbia Basin (USACE 2000; FERC 2001).

Adult UWR chinook salmon begin entering the Willamette River in February. The run peaks in April and entry continues, at lower levels, through June. Adults begin entering spawning tributaries like the McKenzie River as early as mid- to late-April when water temperatures begin to reach 11.1° to 12.2°C. Spawning occurs from August to early November, peaking around the third week in September through the first week in October.

After spawning, UWR chinook salmon eggs remain buried in the gravel for one to four months, depending on stream temperatures. Chinook eggs require 882 to 991 temperature units (TUs) on average before hatching (1 TU = 1˚C above freezing for 24 h). After hatching, the alevins, or yolk-sac fry, remain in the gravel for two to three weeks (depending on stream temperatures).

Historical studies suggest that the majority of juvenile UWR chinook salmon historically reared to age 1 or older in the upper Willamette River basin before outmigrating to the estuary. In the 1940s, spring chinook juveniles were found to outmigrate in the Willamette Basin at different ages and at different times of the year near Lake Oswego on the lower river: 1) age 0+ fry (length 40-90 mm) in late winter/early spring; 2) age 1+ fingerlings (length 100-130 mm) in late fall/early winter; and 3) a second spring peak of age two smolts (length 100-140 mm; Mattson 1962). Less than half of a given age class emigrated as 0+, less than half as age 1+, and less than a third as age 2. This study was conducted after the Willamette River had already been subjected to water pollution for several decades. Thus, the author suggested that historically, juvenile UWR chinook salmon may have continued migrating throughout the summer (Mattson 1962).

Currently, naturally produced juvenile UWR chinook salmon have two peak outmigration periods at Willamette Falls (5 mi upstream of Lake Oswego): 1) age 0+ fry in late winter/early spring, and 2) age 1+ fingerlings in late fall/early winter, a pattern similar to that observed by Mattson in the 1940s. The 0+ group may rear in the lower Willamette or lower Columbia rivers. The age at which each group enters the ocean is not known, nor is it known if survival is higher among one group or the other. Mattson (1963) found that only 8 of 59 (13.5%) returning adults in the McKenzie in 1947 had entered the ocean as subyearlings, suggesting higher survival of juveniles that entered the ocean when they were older and larger. Juvenile UWR chinook appear to emigrate to mainstem areas of major subbasins, including sections of the Willamette River, in late winter and spring and to rear there until smoltification.

ODFW has collected some seine data in the upper mainstem Willamette River each year since 1991, mostly during the summer. Juveniles at various stages of development from fry to smolts have been collected from Peoria (RM 143) upstream to the mouth of the McKenzie River (RM 176). Of particular interest was the capture of numerous newly emergent chinook fry in April

1995 in the reach from Harrisburg (RM 162) to Marshall Island (RM 170). The authors concluded that these were naturally-produced fish because, at that time, hatcheries did not release fish of this size. It is likely that the fish originated from the lower McKenzie River because mainstem habitat below Peoria is less diverse with fewer islands, fewer backwater areas, and a more modified channel, characteristics that reduce its value as rearing habitat for spring chinook salmon (USACE 2000).

As described above, Mattson (1962) reported three distinct migration periods and ages of juvenile spring chinook in the lower Willamette River in the 1940s, and current patterns are similar to this in that the ages and timing of the first two groups are similar. There may have been greater changes in outmigration timing in the tributaries; based on sampling of juvenile UWR chinook salmon in the McKenzie River from 1986-1992, juvenile migration timing appears to have changed over this time period. Samples collected at various locations between 1948 and 1968 indicated that fry migration occurred primarily from March through June (USACE 2000).

In contrast, since 1980, fry have migrated past Leaburg Dam primarily during January through April, earlier than in previous years. Similarly, fingerling migration, which originally peaked during January through March now peaks during October and November. The change in juvenile migration timing may be due to the release of warm water from impoundments above spawning areas during the fall incubation period, accelerating fry emergence and movement (USACE 2000).

UWR chinook salmon are "Gulf of Alaska" migrants. They migrate to the north upon ocean entry and are subject to harvest in British Columbia and southeast Alaska ocean fisheries. Unlike upriver Columbia spring chinook, UWR chinook appear to be highly vulnerable to ocean fisheries. Few adult Willamette spring chinook are caught in Oregon or California ocean fisheries. Commercial seasons are typically not open when the adults are off the coast of Oregon, in preparation for entering the Columbia River during January through May, and few to none, depending on the brood year, are taken off the California coast (USACE 2000).

Mattson (1962) analyzed scales taken from spring chinook salmon caught by sport fishermen in the lower Willamette River during 1946-1950, when most of the returning fish were naturally-produced and the run was comprised of a substantial number of returning adults that were 5 and 6 years old. In comparison, data from the lower Willamette River and Clackamas river fisheries in more recent years indicate that there has been a decrease in the presence of older age classes among returning adult spring chinook salmon since the late 1940s. There has been a steady decline in the proportion of older fish (i.e., age 5 and age 6) over the period 1946 to 1983. The age composition of spring chinook runs returning to the Clackamas and Willamette rivers is currently dominated by age 4 fish (USACE 2000).

1.3.1.4 Habitat and Hydrology

Human activities have affected salmonid populations in the Willamette drainage. The Willamette River, once a highly-braided river system, has been dramatically simplified through channelization, dredging, and other activities that have reduced rearing habitat (i.e., stream shoreline) by as much as 75%. In addition, the construction of 37 dams in the basin has blocked access to over 435 mi (700 km) of stream and river spawning habitat. The dams also alter the temperature regime of the Willamette and its tributaries, affecting the timing of development of naturally spawned eggs and fry. Development and other economic activities also affect water quality. Agricultural and urban land uses on the valley floor, as well as timber harvesting in the Cascade and Coast ranges, contribute to increased erosion and sediment load in Willamette basin streams and rivers. Finally, since at least the 1920s, water quality in the lower Willamette has been affected by runoff and discharge from municipal and industrial development.

1.3.1.5 Hatchery Influence

Hatchery production in the basin began in the late nineteenth century. Eggs were transported throughout the basin, resulting in current populations that are relatively homogeneous genetically (although still distinct from those of surrounding ESUs). Hatchery production continues in the Willamette, with an average of 8.4 million smolts and fingerlings released each year into the main river or its tributaries between 1975 and 1994. Hatcheries are currently responsible for most production in the basin.

The Clackamas River currently accounts for about 20% of the production potential in the Willamette River basin, originating from one hatchery plus natural production areas that are primarily located above the North Fork Dam. The interim escapement goal for the area above North Fork Dam is 2,900 fish (ODFW 1998b). However, the system is heavily influenced by hatchery production and, until recently, it has been difficult to distinguish spawners of natural origin from hatchery fish. Approximately 1,000 to 1,500 adults have been counted at the North Fork Dam in recent years.

1.3.1.6 Harvest

Spring chinook salmon returning to the Willamette basin are caught in ocean and freshwater fisheries, primarily in southeast Alaska and north central British Columbia. In the past, spring chinook were subject to high cumulative harvest rates; the ocean fishery impact rate averaged 22% for the 1975 through 1983 brood years, 14% for 1984 through 1989 brood years, and 9% for 1990 through 1993. Future ocean harvest rates are likely to be in the range of 10% to 20% under the recently completed amendments to the Pacific Salmon Treaty. In freshwater fisheries (the mainstem Columbia and Willamette rivers) the average harvest rate was approximately 36% during 1970 to 2001. Under ODFW's new Fisheries Management and Evaluation Plan, approved by NOAA Fisheries in 2001, anglers must release all unmarked spring chinook; only fin-clipped fish can be retained. The fisheries are managed so as not to exceed a handling mortality rate of 15%, and an average fishery rate of 10% to 11% (ODFW 2001).

1.3.1.7 Population Trends and Risks

For the UWR chinook salmon ESU as a whole, NOAA Fisheries estimates that the median population growth rate (lambda) over the base period[1] ranges from 1.01 to 0.63, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000).

1.3.2 UWR Chinook Salmon in the McKenzie River

Currently, the McKenzie River population is the only population above Willamette Falls with any level of sustained natural production. The McKenzie River Hatchery (Rkm 52), which began egg-taking operations in 1902, obtained a peak collection of 25,100,000 eggs in 1935 (Wallis 1961) from an estimated 7,844 females (@ 3,200 eggs per female). Mattson (1948) estimated that there were 4,780 adults returning to the McKenzie River, and this constituted 40% of the entire run above Willamette Falls. Parkhurst et al. (1950) estimated that there was suitable habitat for 80,000 fish in the entire basin.

The construction of the Cougar Mountain Dam (Rkm 101) in 1963 eliminated 56 km of spawning habitat on the South Fork McKenzie River. The South Fork was generally believed to be the best salmon-producing stream in the McKenzie drainage (USFWS 1948). The Blue River Dam (Rkm 88) prevented access to an additional 32 km of spawning habitat.

NOAA Fisheries has estimated the risk of absolute extinction for the aggregate UWR chinook salmon population in the McKenzie River above Leaburg (the only self-sustaining population in the ESU), using the same range of assumptions, as described above, about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not produced adult returns (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years is 0.01 (Table B-5 in McClure et al. 2000). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 0.85 (Table B-6 in McClure et al. 2000).

[1] Estimates of median population growth rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period beginning in 1980 and including 1998 adult returns. Population trends are projected under the assumption that all conditions will stay the same into the future.

1.4 Evaluating Proposed Actions

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined by 50 CFR Part 402.02 (the consultation regulations). In conducting analyses of habitat-altering actions under Section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations: 1) consider the status and biological requirements of the species; 2) evaluate the relevance of the environmental baseline in the action area to the species' current status; 3) determine the effects of the proposed or continuing action on the species, and whether the action is consistent with the available recovery strategy; 4) consider cumulative effects; and 5) determine whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed or continuing action, the effects of the environmental baseline, and any cumulative effects. If NOAA Fisheries determines that the proposed action is likely to jeopardize, it will identify reasonable and prudent alternatives for the action that avoid jeopardy.

The first step NOAA Fisheries uses when applying ESA Section 7(a)(2) to the listed ESUs considered in this biological opinion is to define the species' biological requirements. Since 1995, NOAA Fisheries has developed the viable salmonid population (VSP) concept as a tool to evaluate whether the population-level biological requirements of ESUs are met (McElhany et al. 2000). VSPs are independent populations that have a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over 100 years. The attributes associated with VSPs include adequate abundance, productivity (population growth rate), juvenile outmigrant production, population spatial scale, and diversity. Biological requirements are met when the independent, naturally-reproducing populations that make up a listed ESU are large and numerous enough to safeguard the genetic diversity of the ESU, enhance its capacity to adapt to various environmental conditions, and allow it to become self-sustaining in the natural environment. At this point, protection under the ESA will become unnecessary. Biological requirements may also be described as the habitat conditions necessary to ensure the species' continued existence (i.e., functional habitats) and these can be expressed in terms of physical, chemical, and biological parameters. The manner in which these requirements are described, as population variables or as habitat parameters, varies according to the nature of the action under consultation and its likely effects on the species.

Whether species' biological requirements are expressed as population or habitat parameters, there is a strong causal link between the two: actions that affect habitat have the potential to affect population abundance, productivity, and diversity. By examining the effects of a given action on the habitat portion of a species' biological requirements, NOAA Fisheries can gauge how that action will affect the population parameters that constitute a species' biological requirements and, ultimately, how the action will affect the species' current and future health.

Ideally, reliable scientific information on a species' biological requirements would exist at both the population and the ESU levels, and effects on habitat should be readily quantifiable in terms of population-level impacts. In the absence of such information, NOAA Fisheries' analyses must rely on generally applicable scientific research that one may reasonably extrapolate to the action area and to the population(s) in question. For actions that affect freshwater habitat, NOAA Fisheries usually defines the biological requirements in terms of a concept called properly functioning condition (PFC). PFC is the sustained presence of natural[2] habitat forming processes in a watershed (e.g., riparian community succession, bedload transport, precipitation runoff pattern, and channel migration) that are necessary for the long-term survival of the species through the full range of environmental variation. PFC constitutes the habitat component of a species' biological requirements. The indicators of PFC vary between different landscapes based on unique physiographic and geologic features. For example, aquatic habitats on timberlands in glacial mountain valleys are controlled by natural processes operating at different scales and rates than are habitats on low-elevation coastal rivers.

In the PFC framework, baseline environmental conditions are described as "properly functioning," "at risk," or "not properly functioning." If a proposed action would be likely to impair[3] properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it will usually be found likely to jeopardize the continued existence of the species (or adversely modify its critical habitat or both, depending upon the specific considerations of the analysis). Such considerations may include, for example, the species' status, the condition of the environmental baseline, the particular reasons for listing the species, any new threats that have arisen since listing, and the quality of the available information.

NOAA Fisheries typically considers the status of habitat variables in a Matrix of Pathways and Indicators (MPI; see Table 1 in NMFS [1996]), which was developed to describe PFC in forested montane watersheds. NOAA Fisheries relies on these pathways and indicators because they are supported in the scientific literature as being affected by land management activities, and are relevant to the survival and recovery of the freshwater life stages of Pacific salmon.

1.4.1 Environmental Baseline

The environmental baseline is defined as "the past and present impacts of all Federal, state, or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 and the impacts of state and private action that are contemporaneous with the consultation in progress" (50 CFR

[2]The word "natural" in this definition is not intended to imply "pristine," nor does the best available science lead NOAA Fisheries to believe that only pristine wilderness will support salmon.

[3]In this document, to "impair" habitat means to reduce habitat condition to the extent that it does not fully support long-term salmon survival. Therefore, "impaired habitat" is that which does not perform that full support function. Note that "impair" and "impaired" are not intended to signify any and all reduction in habitat condition.

402.02). In step 2, NOAA Fisheries evaluates the relevance of the environmental baseline in the action area to the species.

1.4.1.1 McKenzie River Watershed

The McKenzie River subbasin covers an area of approximately 1,300 square miles on the western slope of the Cascade Mountains; the mainstem is approximately 90 miles long. The major tributaries are the South Fork McKenzie, Blue, and Mohawk rivers (Fig. 1-1). The McKenzie River originates high on the western slopes of the Cascade Range. Much of the McKenzie River subbasin is mountainous with steep ridges and a narrow band of level land in the valleys along the McKenzie and Mohawk rivers. Although the mainstems of the McKenzie River and the Mohawk River have relatively low gradients, most of the other tributaries have steep gradients in their upper reaches. The headwaters of the McKenzie River are characterized by a broad, gently sloping volcanic ridge that extends west from the steep peaks of the Three Sisters Mountains.

The profile of the upper river generally reflects the transition from resistant volcanic parent material through the more easily erodible tuffaceous sedimentary rock and glacial landforms. The channel slope decreases from 1.2% upstream of Belknap Springs to less than 0.4% through the glacial valley just upstream from the mouth of Blue River. Downstream of Blue River the channel slope remains between 0.2 to 0.4%, but the channel is tightly confined within a narrow canyon for approximately 20 miles. The slope flattens abruptly to less than 0.2% as the river enters the wide Willamette Valley.

The largest town in the subbasin is Springfield (population approximately 52,000; PSU 1998), which is also partially located in the upper Willamette and Middle Fork Willamette subbasins. There are several smaller towns and a large number of rural residents in the subbasin. The largest dams are USACE's Cougar Dam on the South Fork McKenzie (RM 4.5; completed in 1963) and Blue River Dam on the Blue River (RM 1.8; completed in 1968). The other major dams in the subbasin are EWEB's Carmen and Trail Bridge dams on the upper McKenzie River, and Smith Dam on the Smith River (Fig. 1-1). Other dams and diversions withdraw water from the lower McKenzie River and its tributaries in significant amounts during the summer and fall. The floodplains and channels of the lower McKenzie and its tributaries have been simplified by riprapping and filling for agriculture, urban development, highways, and other development (EA 1991a).

Approximately 70% of the McKenzie River subbasin is public land; most of the upper subbasin is managed by Willamette National Forest (WNF) and a much smaller proportion of the subbasin is managed by the Bureau of Land Management's Eugene District (BLME). The headwaters originate in the Three Sisters Wilderness area of WNF. Cougar and Blue River dams, and most of their reservoirs, are located within WNF (Fig. 1-1). Forest road construction and timber harvest have been extensive on both public and private land in the McKenzie River subbasin.

The subbasin is used extensively for recreational purposes, and the McKenzie River is one of the most popular rivers for fishing and boating in Oregon. Much of the lower McKenzie River subbasin is described in watershed analysis reports by BLME (1995, 1996, 1998) and EWEB (EA 1991a, 1991b). Watersheds in the upper basin are described in watershed analysis reports by WNF (WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997). In addition, the McKenzie Watershed Council (MWC) has completed an assessment of water quality and habitat for the entire subbasin (MWC 1996).

The September 6, 2001, Biological Opinion (NMFS 2001) that requires the facilities discussed herein is an important factor affecting the baseline. The effects of the proposed action will be viewed in the context of the requirements of the September 6, 2001 biological opinion. The short term impacts will be weighed against the longer term benefits of each passage structure. In addition, biological opinions addressing structure constructed in 2002 (NOAA Fisheries 2002a, NOAA Fisheries 2002b) are also considered important factors affecting the baseline.

1.4.1.2 Physical Habitat within the Action Area

Flood control operations at Cougar and Blue River dams have decreased the magnitude and frequency of peak flow events that historically recurred every 10 to 100 years downstream of the dams. Prior to the construction of Cougar and Blue River dams, the highest flow recorded on the McKenzie River at the Vida gage was 64,400 cfs in December 1945 and flows greater than 40,000 cfs were not uncommon (USACE 2000).

Before the completion of Cougar and Blue River dams, the magnitude of floods recurring on an average interval of every 10 years (the 10-year flood) was approximately 50,000 cfs at Vida, 12 miles below the confluence of the South Fork (Fig. 1.4-1). Since the completion of the flood-control projects, the magnitude of the 100-year flood (i.e., a major flood) has been reduced to less than the pre-dam, 10-year flood. Another way of looking at the data represented in the graph in Fig. 1.4-1 is to compare the pre- and post-dam magnitude of floods at a selected recurrence interval. For example, the 10-year flood has decreased from approximately 50,000 cfs at the Vida gage before the dams to approximately 26,000 cfs after the dams at the Vida gage (Fig. 1.4-1). On the South Fork below Cougar Dam, the magnitude of the ten-year flood has decreased from approximately 19,000 cfs to approximately 6,000 cfs at the gage just below the dam (Fig. 1.4-2). The construction of EWEB's Carmen, Smith, and Trail Bridge dams in the 1960s in the upper subbasin had minimal effects on flood magnitude due to much smaller storage capacities than Cougar and Blue river dams. An indirect effect of flood control by Cougar and Blue river dams has been the encroachment into the floodplain by agriculture and other development that would have been prevented by floods in the absence of the dams.

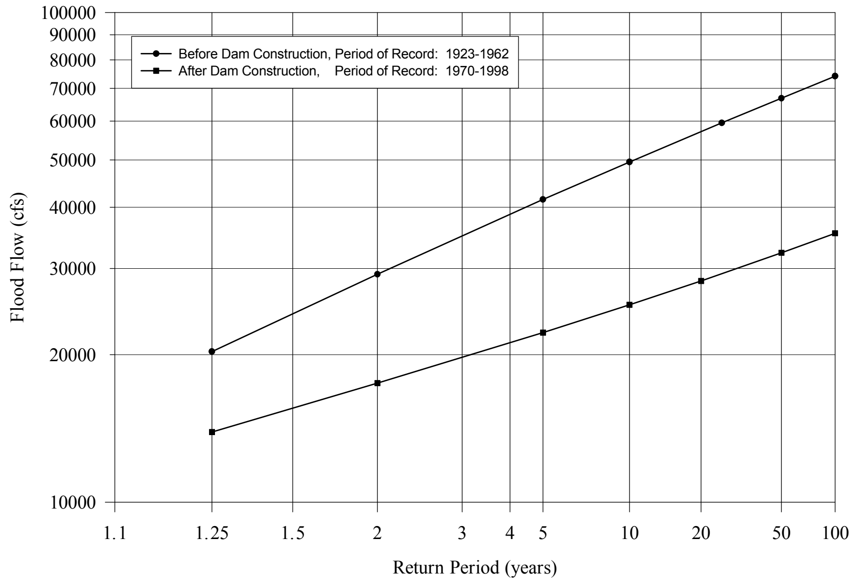

Figure 2. Flood frequencies at the Vida gage on the McKenzie River (USGS gage 14162500 at RM 47.7) before and after the construction of Blue River, Cougar, Carmen, Smith, and Trail Bridge dams. The gage is located 12 miles downstream of the South Fork McKenzie River's confluence with the mainstem McKenzie (from Fig. F-22 in USACE 2000).

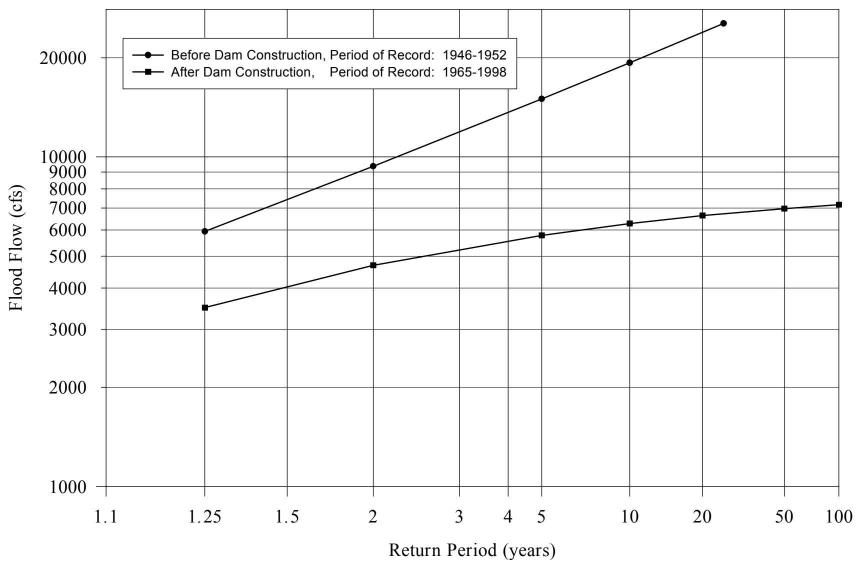

Figure 3. Flood frequencies at Rainbow on the South Fork McKenzie River (USGS gage 14159500 at RM 3.9) before and after the construction of Cougar Dam. The gage is one-half mile below the dam (from Fig. F-17 in USACE 2000).

Upstream of Cougar and Blue River dams and in other McKenzie River tributary watersheds, the environmental baseline with regard to disturbance is dominated by the effects of the three largest floods in the past 60 years, the 1945, 1964, and 1996 floods, combined with the effects of human activities. That is, these floods, especially the latter two, occurred after large stream channels had been considerably simplified through the results of road construction and large wood removal, for example. The floods then scoured many of these stream channels and washed much of the existing substrate and large wood downstream. The occurrence of these large floods in streams already altered by human activities has resulted in simplified, monotypic stream channels in much of the McKenzie subbasin above the dams and in tributary watersheds (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997).

The processes of sediment and large wood function in various locations throughout the McKenzie subbasin have been characterized both by Federal agencies (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997) and others (EA 1991a; Minear 1994). The largest changes in sediment and large wood function from historical conditions are evident in 6th field HUC and larger stream channels in this and other Willamette subbasins. Generally, delivery of nonorganic sediment (rock and fine sediment) to stream channels upstream of dams has increased due to erosion caused by human activities, but the ability of these channels to retain sediment has decreased due to structural simplification of channels. Important agents in channel simplification have been the reduction in large wood and isolation of channels from their floodplains, both caused by a variety of human activities. The current function of sediment and large wood within stream channels reflects these changes, but the manner in which stream channels have responded to such changes depends on several factors such as channel type and gradient.

The relatively unconstrained, low gradient reaches of 5th and 6th field HUC streams historically were structurally complex and spatially diverse, having high densities of large wood, side channels, islands, gravel bars, and pools. Upstream of the major dams in the McKenzie subbasin, these low gradient reaches have typically responded to increased sediment and decreased large wood by channel widening and simplification. Constrained, high gradient reaches historically were less complex than the low gradient reaches, but large wood provided sediment retention and structural complexity. With the reduction in large wood, these high gradient reaches have typically responded by transporting sediment more efficiently (even when more sediment is available), resulting in widespread downcutting to bedrock or boulders/large cobbles (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997). Downstream of large dams, stream channels are deprived of all types of sediment (nonorganic and large wood), thus they typically respond differently to human activities than unregulated streams.

In the mainstem McKenzie River (a 4th field HUC stream), channel bed material is generally armored and composed of cobble and larger material because the river has a large transport capacity relative to sediment availability and fine material is rapidly transported downstream. Leaburg Dam initially blocked the downstream transport of sediment in the lower McKenzie River when it was constructed in 1929, resulting in downcutting of 1-5 ft. However, Leaburg Lake has since filled in and passes gravel to spawning areas located downstream below Leaburg Dam. The five other major dams in the upper subbasin (Carmen, Smith, Trail Bridge, Blue River, and Cougar) alter the hydrology and trap sediment from over 35% of the watershed. The completion of Blue River and Cougar dams reduced the area supplying sediment to the mainstem McKenzie River by 23%. These dams act as sediment traps, with coarser material (gravel and larger rock) settling out at the head of the reservoir, and most of the finer sediment settling out within the reservoir. In addition, most woody material is prevented from going past USACE dams and large log rafts may collect on the reservoirs after floods (USACE 2000).

In addition to trapping sediment from a large portion of the upper subbasin, the alteration in flow regime by Blue River and Cougar dams has reduced the river's ability to transport sediment produced by natural weathering processes in the upper subbasin. Prior to dam construction, peak flows with a 5-year recurrence interval at the Vida gage were able to move sediments up to 150 mm in diameter, the estimated historical median particle size (Minear 1994). After dam construction, the peak flow corresponding to a 5-year return interval was reduced from over 40,000 cfs to about 22,000 cfs; this flow is no longer able to mobilize the median substrate particle size (150 mm diameter). Aerial photos taken in 1945-1946 and in 1986 indicated that adjustments to these factors caused a 57% decrease in the area of exposed gravel bars and possible coarsening of mainstem substrates (Minear 1994). The sediment supply to most of the subbasin is still routed downstream through undammed reaches. Thus, the effects of armoring are localized compared to subbasins where dams entirely block the sediment supply to the mainstem.

The length of side channels in the unconfined reach downstream of the confluence with the South Fork McKenzie River (above Leaburg Dam) decreased from almost 6,000 ft in 1946 to just over 3,000 ft in 1986 (Minear 1994). The area of gravel bars also decreased during this same time period, from over 30 acres to 3 acres. These data suggest that the main channels in these reaches are downcutting and disconnecting from side channel habitats. The effects will probably continue until an armor layer develops; there are presently no data as to whether this has occurred (USACE 2000). The reach downstream of Leaburg Dam has been responding to a similar reduction in sediment supply for a longer time period. The area of islands and length of stream margin habitat decreased from approximately 540 acres and 117,000 linear ft respectively in 1930, to approximately 270 acres and 95,000 linear ft in 1990. The area of off-channel sloughs increased from approximately 39 acres in 1930 to 51 acres in 1990 (EA 1991a).

Large wood has been directly removed from stream channels of all sizes in the McKenzie subbasin during the twentieth century. Large wood was directly removed from lower subbasin stream channels in the early twentieth century as a result of splash damming (BLME 1995). More recently, the practice of "stream clean-out" from the 1950s to the 1970s directly reduced large wood in many streams in the McKenzie subbasin. Logjams and other large wood were removed from stream channels on both public and private land in a misdirected effort to improve fish passage, for timber salvage, and to reduce downstream damage during floods to bridges. Currently, large wood is often removed by boaters from the mainstem McKenzie River channel to prevent navigation hazards. The subsequent simplification of stream channels allows sediment to be flushed downstream, thereby depriving the channel of material required for building streambanks and gravel bars (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997).

Construction of Cougar and Blue River dams disrupted the downstream transport of large wood to downstream reaches. Wood and organic material trapped behind the dams would have eventually been transported to the McKenzie River. As evidence, the amount of large wood in the McKenzie River between the confluence with the South Fork McKenzie and Leaburg Dam decreased from 12 large aggregations and 3 large single logs in 1930, to 4 aggregations and 1 large single log in 1991 (Minear 1994). Because Leaburg Dam is a run-of-river project, high flows pass over the spillway, allowing most large wood to continue downstream rather than trapping it as occurs at Cougar and Blue River dams.

The degree to which dams disrupt the downstream transport of large wood is presumed to be less severe, relative to other land use activities in the McKenzie River subbasin, than in upper Willamette subbasins with mainstem dams. In the case of the McKenzie subbasin; the river still transports wood from unregulated tributaries. However, in the past, it was common practice for landowners and river guides to remove large wood from the channel for flood control and navigation purposes or to sell pieces that were marketable (Minear 1994). Much of the in-channel large wood in the mainstem near the confluence with the South Fork was removed during intensive logging of the riparian area in the 1950s. The relatively young, existing riparian stands and the disruption of downstream large wood transport by Cougar and Blue River dams will continue to depress large wood recruitment rates to the lower McKenzie River (Minear 1994).

The acreage covered and functional value of riparian vegetation of the McKenzie subbasin has been greatly reduced during the twentieth century. Much riparian vegetation was removed for farmland, residences, timber harvest, and roads. In some cases, all woody vegetation on streambanks has been removed. For example, as of 1990, more than 11 miles of streambanks in the lower McKenzie River were protected by riprap or revetments built by USACE (USACE 2000). In the higher elevations of the subbasin, roads parallel stream channels and cut through riparian areas immediately adjacent to many streams. The construction of Highway 126 altered the McKenzie River's historical riparian character with the addition of roads, ditches, turnouts, and other road-related development. Secondary road construction and timber harvest activities in much of the subbasin have eliminated or greatly reduced riparian vegetation along most streams (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997). Cougar Reservoir inundated 1,280 acres, including 200 acres of riparian hardwoods and 1,600 acres of old-growth conifers (BPA 1985). Blue River reservoir inundated 975 acres of stream channels, riparian forest, and upland forest (USACE 2000).

The amount of riparian habitat adjacent to the lower McKenzie River is estimated to have been reduced from 1,607 acres in the 1930s to less than 930 acres in 1990 (EA 1991b). In the lower subbasin, riparian vegetation consists of narrow, sparse stands of shrubs or trees with poor to fair near-term large wood recruitment potential, and poor long-term recruitment potential, assuming current land-use practices. Riparian vegetation and future large wood recruitment potential improves along an upstream gradient. In much of the subbasin, three non-native invasive species dominate riparian areas: Himalayan blackberry, Scotch broom, and reed canary grass.

Downstream of the South Fork McKenzie River, vegetation has become established on gravel bars and other surfaces that were formerly regularly inundated, making them more resistant to erosion during flooding. This has resulted in dramatic changes in channel configuration and has reduced the area of exposed gravel bars in the wide, low gradient valley downstream of the South Fork McKenzie. A reduction in the total area of gravel bars was also noted in the canyon reach downstream of the confluence with Blue River, although the number of side channels increased (Minear 1994). As with reduction in peak flows and sediment supply, establishment of vegetation on formerly unstable bars has been an agent of channel change in the McKenzie system (USACE 2000).

Historically, the lower, unconfined section of the McKenzie River downstream of Leaburg Dam contained frequent, mid-channel bars and islands, and multiple channels that periodically shifted from one side of the river to the other. Shear stress was high because the river gradient was still steep relative to discharge, and high flows were capable of transporting sediment larger than 256 mm in diameter. The river probably had an armored cobble bed within this reach, although there was substantial hydraulic roughness causing deposition of finer gravel and sand (EA 1991a). Over the entire reach of the McKenzie River below Leaburg Dam, the effects of altered flow regime and construction of flood control structures (levees and revetments) are believed to have had a greater influence on channel morphology than reduced sediment supply. Such effects and actions would serve to prevent flows capable of creating new bars and islands, constrict the channel and prevent bank erosion, and allow encroachment of perennial vegetation on formerly active bar surfaces (EA 1991a).

To provide protection from flooding, USACE recommended in 1947 that nearly continuous levees with an average height of 7 ft be constructed along the lower McKenzie River downstream of RM 22. As of 1990, more than 11 miles of streambanks in the lower McKenzie River were protected by riprap or revetments. These are located primarily along the outside of meander bends, and are concentrated in the heavily populated valley near the confluence of the McKenzie with the Willamette River. There are no levees or revetments constructed or maintained by USACE in the vicinity of Blue River and the South Fork McKenzie River (USACE 2000). Riprap banks retard or prevent the formation of mid-channel bars and islands in the McKenzie River that are normally created and maintained by bank erosion and recruitment of sediment from streambanks. As a result, the channel form has been simplified and the bed has become comprised of an increasingly homogenous mixture of cobbles with few gravel deposits present. The dominant particle size is 152 mm and the D_{50} (average) is 119 mm, sizes approaching the maximum size used by spawning salmon (EA 1991a).

Riparian vegetation has been reduced by road construction, agriculture, timber harvest, gravel mining, riprap, reservoir inundation, and urbanization. Downstream of USACE dams, riparian vegetation has encroached on surfaces that were regularly inundated before the dams were built, resulting in channel narrowing and gravel bar reduction. In the lower reaches of the largest streams, formerly wide floodplains and complex stream channels have been simplified by the removal of riparian vegetation, filling of secondary channels, and other backwaters, and hardening of streambanks with riprap. These simplified conditions are maintained by the reduction in floods, sediment, and large wood by USACE and EWEB dams, as well as the hardening of streambanks and ongoing development of the floodplain.

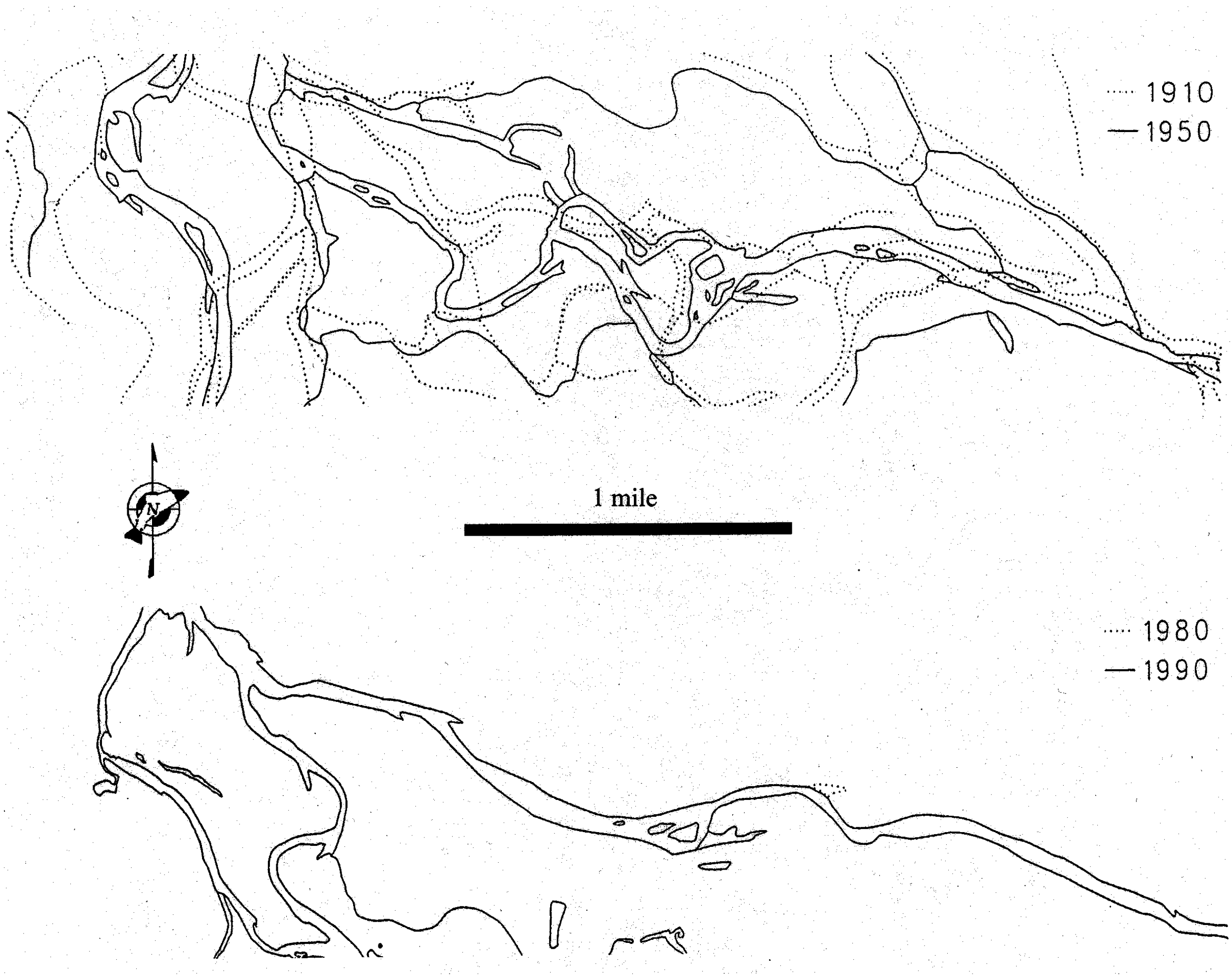

Figure 4. Channel simplification along the lower McKenzie River (flowing east to west through center of figures) from 1910 to 1990 at the confluence with the Willamette River (flowing south to north on left side of figures; EA 1991a).

UWR chinook salmon historically migrated through much of the McKenzie subbasin to take advantage of abundant spawning and rearing habitat. The mainstem McKenzie River is free of natural migration barriers to adult salmonids up to Tamolich pool at approximately RM 81 (WNF MRD 1995), above which the river is subsurface for several miles. Adult chinook salmon historically migrated up to this point in the upper mainstem McKenzie River to spawn, as well as the upper reaches of all the major tributaries such as the Mohawk River, Blue River, South Fork McKenzie River, Horse Creek, and many smaller streams. Spawning occurred throughout these streams where habitat was available, including the mainstem McKenzie River down to the confluence with the Willamette River. Juvenile chinook salmon migrated downstream to suitable rearing habitat in all these streams and the mainstem Willamette River, depending on their life history stage and the environmental conditions (USACE 2000).

Migration conditions for chinook salmon in the McKenzie subbasin were altered from historical conditions by at least one hatchery rack (weir) on the lower mainstem, numerous dams on the mainstem and many tributaries that created barriers, and flow regimes that were altered by the dams and other human activities. One of the earliest obstructions to fish migration was a hatchery rack on the lower McKenzie River at approximately RM 18. This rack, which intercepted the entire spring chinook salmon run, was operated from 1902 through 1957 to collect eggs for a state fish hatchery. Fish spawned from this rack were used for stocking the McKenzie River system, as well as other sites in Oregon and other states. Adult passage of a portion of the population was allowed upstream past the rack starting in 1954 after a major decline in the spring chinook runs was noted (USACE 2000).

Several EWEB hydroelectric projects have altered migration conditions for chinook salmon in the mainstem McKenzie River by creating barriers to migration. Shortly after the hatchery rack began operation on the lower mainstem McKenzie River, EWEB built the Walterville Project. EWEB began diverting water in 1911 from the mainstem McKenzie River at approximately RM 28 into a 4-mile long, 14-ft deep, unscreened canal that diverted water downstream to the Walterville Powerhouse. While the canal does not block the mainstem or prevent the upstream migration of adult chinook salmon, the return flow to the river attracts adults into the tailrace canal where there is the potential for delay in their spawning migration. At the Walterville Canal intake, over 70% of the river flow can be diverted during summer when adult spring chinook may still be moving upstream, potentially hindering migration through the bypassed reach.

In 1930, EWEB also constructed the 22-ft high Leaburg Dam at RM 39 to divert water from the resulting 57-acre reservoir into a 5-mile long canal. The dam has two fish ladders. The Leaburg Canal is now fitted with juvenile fish screens and a bypass system returns juvenile fish to the McKenzie River just below the Leaburg Dam (USACE 2000). According to FERC (2001), current levels of mortality of downstream migrating fry and smolt chinook salmon passing through Leaburg Dam are low, although the results of field tests using smolts are described as inconclusive.

The September 6, 2001, biological opinion required EWEB to construct fish screens at the Walterville hydroelectric project, modify the existing fish screens at the Leaburg Hydroelectric project, construct tailrace barriers at both the Walterville and Leaburg Hydroelectric projects, modify the Leaburg left bank fish ladder, construct a new right bank fish ladder, ensure unimpeded fish passage is provided over the Walterville rock drop structures, and mitigate any additional injury and/mortality of juvenile fish associated with raising Leaburg Lake. In 2002, EWEB constructed the first of these facilities, which are now operating (Walterville Fish Screens, Walterville Tailrace Barrier, and Leaburg left Bank fish ladder). The facilities included in the September 6 biological opinion, should mitigate to the extent possible, the alterations of fish passage by EWEB's Leaburg-Walterville Hydroelectric Project.

The construction and operation of weirs, diversions, and dams is the most obvious manner in which human activities have altered historical migration conditions for adult and juvenile chinook salmon in the McKenzie subbasin but there have been other human-induced changes. Adult chinook salmon enter the McKenzie River from late spring to early summer, then hold in deep pools until spawning in the fall. These holding pools are a critical component of migration habitat for adult chinook salmon. Sedell et al. (1992) found a 19% reduction in the number of large pools from 1937 to 1991 in the McKenzie River from RM 24 to RM 82, including an 85% reduction in the 15 RM downstream of Leaburg Dam. The important spawning tributaries of the South Fork McKenzie River and Horse Creek also had large pool reductions of 75% and 38%, respectively, during this time period. Loss of pool habitat is attributed to reductions of pool forming processes, including peak flow events and LW, and effects of forest management activities including road building and logging.

The USACE flood control dams (Cougar and Blue River) have altered the flow regime such that late winter and spring flows are lower, and water temperatures such that summer temperatures are cooler and fall temperatures are warmer than those observed historically. The management of Cougar Dam results in colder than natural stream temperatures in August and September below the dam in the South Fork and mainstem McKenzie rivers, followed by a sudden temperature increase as the summer pool is drained such that stream temperatures are warmer than natural in October. As adult UWR chinook salmon approach the South Fork on their spawning migration in the late summer, they delay entering the stream because of the cold temperatures or spawn elsewhere. Of those that do enter the South Fork, prespawning mortality is approximately five times as high as fish spawning in the mainstem above the mouth of the South Fork (USACE 1995; NMFS and USFWS 2000).

Because chinook salmon fry migrate in the late winter from the McKenzie subbasin, reduced flows at this time of the year could affect their migration. Less direct changes in juvenile chinook salmon migration conditions induced by human activities include water quality degradation, which prevents juvenile chinook salmon from using some historical rearing habitat in the lower subbasin (e.g., Mohawk River); and the introductions of warm-water species, which compete with or prey upon juvenile chinook salmon in the lower subbasin (e.g., sloughs off of the lower mainstem McKenzie near the Willamette confluence [USACE 2000]).

Current migration timing is as follows: returning adult UWR chinook salmon enter the McKenzie River as early as mid- to late-April, when water temperatures reach 11.1-12.2° C. Migration timing of spring chinook salmon adults in the Willamette basin has been shown to be very temperature dependent. The period of peak passage above Leaburg Dam (~RM 39) occurs in the first half of June on average, but can occur as early as the second half of May in warmer water years or as late as the first part of July in cooler water years. Therefore, the timing of upstream migration to the remaining spawning habitat is probably affected by changes in water temperature caused by the dams. A smaller pulse of adults moves above the dam just prior to and during the spawning period in September. Juvenile UWR chinook salmon migrate downstream from spawning and incubation areas to the lower McKenzie River or to the Willamette River in the late winter or early spring as fry (age 0+). More than 90% of the naturally- produced juveniles captured at Leaburg Dam between 1980 and 1983 were fry (FERC 2001).

Historically, UWR chinook salmon spawning occurred throughout the mainstem McKenzie River and in all the major tributaries such as the Mohawk River, the South Fork McKenzie River, Horse Creek, and many smaller tributaries (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997). Spawning in the McKenzie River started in early to mid-August and lasted as late as the third week of October, but now largely takes place during September (USACE 2000; FERC 2001). Spawning may have been especially prolific in the lower reaches of the mainstem McKenzie River. For example, in 1946-1947, spring chinook spawning occurred primarily in the lower 20 miles, near the Hayden, Coburg, and Hendrick’s bridges. Chinook spawners were also located in large numbers at Wilson’s Bend near the mouth and the lower section of the Walterville Canal because of the presence of a rack placed in the river to collect fish for hatchery production (Mattson 1948).

Currently, the McKenzie subbasin supports the largest spawning aggregation of UWR chinook salmon. Above Leaburg Dam at RM 39, an estimated 70% of the spring chinook salmon spawners passing above the dam from 1994 to 1998 were naturally produced and therefore protected under the ESA. Downstream of Leaburg Dam, most chinook salmon spawners are hatchery produced and therefore not protected (USACE 2000). Based on aerial redd surveys, approximately 10-20% of the chinook salmon above Leaburg Dam spawn in the South Fork of the McKenzie below Cougar Dam, 30-40% spawn in the mainstem McKenzie River below the confluence with the South Fork, and 45-60% spawn in headwater areas above the confluence with the South Fork up to Trail Bridge Dam (USFWS 1994; ODFW 1999b). Because these redd surveys were done from the air, redds in side channels, tributaries, and near streambanks were obscured from view by vegetation and thus probably undercounted.

Minear (1994) observed that reduced sediment supply and flow alteration by dams on the mainstem McKenzie River, Blue River, and the South Fork McKenzie River in the 1960s altered the flow regime and cut off sediment supply from the upper half of the drainage area. Aerial photographs taken in 1945/1946 and in 1986 indicated that adjustments to these factors caused a 57% decrease in the area of exposed gravel bars and possible coarsening of mainstem substrates. Sedell et al. (1992) found that the substrate in the some reaches of the mainstem McKenzie River that are still accessible to chinook salmon has coarsened in the last 60 years, although the 15-mile reach between Hendricks Bridge and Leaburg Dam actually decreased in percent large rubble (from 49 to 35%) while increasing in percents medium rubble, small rubble, and fine sediment.

Ligon et al. (1995) observed that an average of 8.5 female chinook salmon were counted per redd in a reach of the McKenzie River above Leaburg Dam during the period 1970-1986. The authors state that it is likely that spawning-gravel limitations are resulting in redd superimposition. However, the female/redd estimate was derived from Leaburg Dam counts and aerial redd counts (assuming a 1:1 sex ratio) and aerial counts in the upper McKenzie River basin have been shown to significantly under-count the number of redds based on a comparison with ODFW ground surveys (Grimes et al. 1996; Lindsay et al. 1997). This is thought to be due to the narrowing of the channel, overhanging riparian vegetation, and the propensity for chinook to spawn along the margins which inhibit the view from the air. As a result, aerial counts in the upper McKenzie basin, which could overinflate estimates of females/redd, were discontinued after 1997 (pers.comm., Tim Downey, EWEB, August 17, 2001). Further, USACE (2000) reports that only 1% of the available spawning gravel is used by chinook salmon in the mainstem McKenzie River. Thus, evidence regarding whether spawning gravels of adequate quantity and quality are available to UWR chinook salmon under the environmental baseline is inconclusive at this time.

In the tributaries of the McKenzie River, spawning habitat that is still accessible to chinook salmon has been altered by a combination of human activities. In the upper subbasin, important undammed spawning tributaries such as Horse and Lost creeks still provide abundant spawning gravels and high water quality, although these conditions have become somewhat altered by recent road construction, LW removal, and timber harvest (WNF MRD 1995, 1997). In the lower subbasin, spawning habitat has been much more affected by human activities (splash damming, irrigation diversion, and channel simplification) that started during the early 20th century (BLME 1995, 1998). As a result, chinook salmon spawning habitat in these lower subbasin tributaries has been altered through sedimentation of spawning gravels and deterioration of water quality.

The McKenzie River Trust is an Oregon non-profit corporation established in 1989 and dedicated to protecting lands in the McKenzie River watershed. The Trust is developing a scientifically-based method for identifying, evaluating, and selecting specific high quality habitat property, using the combined inputs of EWEB, the MWC, ODFW, Oregon Trout, NOAA

Fisheries, and others. This method includes steps that consider the habitat needs of spring chinook salmon and bull trout. EWEB has granted $500,000 to the McKenzie River Trust and pledged up to $500,000 as an additional matching grant for contributions to purchase land and/or conservation easements in the McKenzie River watershed to further watershed health objectives. These objectives include maximizing protection of critical fish and wildlife habitat of the McKenzie River, minimizing the need for future public expenditures for habitat restoration, and promoting cooperative approaches to protection of fish and wildlife habitat. The land trust will provide both short- and long-term benefits for both species of fish (FERC 2001, NMFS and USFWS 2001).

Little information is available on historical rearing strategies of juvenile UWR chinook salmon in the McKenzie subbasin. Juveniles were observed moving downstream beginning in February and continuing throughout the year (Craig and Townsend 1946), and analysis of scales from adults returning to the McKenzie River in 1947 indicated that 13.5% (8/59) had entered the ocean as subyearlings (Mattson 1963). As described above, currently most UWR chinook salmon juveniles in the McKenzie subbasin migrate downstream soon after emergence as fry (age 0+), but some rear in the McKenzie River and then outmigrate as fingerlings (age 1+). Samples collected at various locations in the McKenzie River between 1948 and 1968 indicated that fry migrated from the system primarily during March through June. Fry migration past Leaburg Dam since 1980 has occurred primarily during January through April; thus, fry migration has occurred earlier than in previous years. Likewise, fingerling migration in the McKenzie River peaked in January through March during 1948 through 1968, and now peaks in October and November. This change in juvenile migration timing may be due to the release of warm water from the two USACE reservoirs above spawning areas during the fall incubation period, and the consequent acceleration of fry emergence (USACE 2000). The early emerging fry are now faced with a much longer period of unfavorable wintertime conditions (USACE 1995; NMFS and USFWS 2000).[4]

Rearing habitat is used by juvenile UWR chinook salmon for feeding and growth between emergence and entry into the estuary. Within the McKenzie subbasin, rearing habitat for juvenile UWR chinook salmon is provided by side channels and river margins along the mainstem and, to a lesser degree, tributaries such as the South Fork McKenzie River (WNF BRRD 1995; USACE 2000). The lower mainstem of the McKenzie River historically provided abundant UWR chinook salmon rearing habitat, especially in the lower, alluvial reaches where the river and floodplain were a complex mosaic of main channels, side channels, islands, sloughs, and wetlands (Fig. 5-5 above).

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[4]UWR chinook salmon eggs incubate in the gravel for one to four months, depending on water temperature. Chinook eggs require about 416 temperature units (TUs) to hatch (one TU = 1° C above freezing for one day), and an additional 472 TUs for fry to emerge from the gravel. However, the alteration of the water temperature regime in the McKenzie River, due to the existing operations of Cougar and Blue River dams, has accelerated the emergence timing of spring chinook fry by up to 85 days, most likely reducing fry survival (FERC 2001).

Much of the historical rearing habitat has been either lost or simplified during the 20th century as the function of the lower subbasin's floodplains has been impaired by peak flow reduction (due to dams), sediment supply reduction (due to trapping of gravel behind dams, streambank hardening by riprap and vegetation encroachment, and gravel mining), loss of LW, and transformation of many floodplain areas to fields, gravel mining quarries, roads, buildings, and other developments. The river is not only unable to create new floodplain complexity (e.g., gravel bars, side channels, LW aggregations) during peak flows, but cannot maintain existing structural complexity. As islands, side channels, and LW are lost without being replaced, the structure of the entire stream channel simplifies and rearing habitat is consequently lost. The remaining rearing habitat is in some cases affected by deteriorating water quality and the presence of introduced predator species.

In summary, USACE dams have reduced the frequency and size of floods in the largest stream channels from those observed historically. Fire suppression has reduced the frequency of fires and has increased fuel loads. Road construction, timber harvest, and other activities have increased mass wasting in some watersheds.

Both USACE dams and EWEB's Carmen-Smith Project have interrupted sediment transport in the largest stream channels, trapping it behind the dams and reducing sediment load, thus causing downcutting and substrate coarsening of these stream channels below the dams. In streams not affected by USACE or EWEB dams, road construction, agriculture, timber harvest, and other land use practices have increased sedimentation of stream channels. In nearly all 6th field HUC and larger stream channels, a combination of dams and land-management practices have reduced LW from historical levels, contributing to stream channel simplification.

The function of the McKenzie subbasin's floodplains has been impaired by peak flow reduction (due to dams), sediment supply reduction (due to trapping of gravel behind dams and streambank hardening by riprap and vegetation encroachment), loss of LW, and transformation of many floodplain areas to fields, roads, buildings, and other developments. The river is not only unable to create new floodplain complexity (e.g., gravel bars, side channels, LW aggregations) during peak flows, but cannot maintain existing structural complexity. As islands, side channels, and LW are lost without being replaced, the structure of the entire stream channel simplifies. An example of stream channel and floodplain simplification along the lower McKenzie River is shown in Figure 4.

The USACE dams block the upstream adult migration of UWR chinook salmon into large portions of their historical spawning habitat in the McKenzie River subbasin. In the case of Cougar Dam, a USACE project completely blocks access is to what was, historically, the most productive portion of the subbasin. The timing of upstream migration to remaining spawning habitat is probably affected by changes in water temperature downstream from the dams, caused by seasonal patterns of thermal stratification and mixing in the reservoirs. Two of the three dams comprising EWEB's Carmen-Smith Project, Trail Bridge and Smith dams, block access to historical spawning areas (Carmen Dam is above a natural barrier to migration). Neither the Leaburg or Walterville diversions totally blocks fish passage but the structures and related facilities cause mortality of juvenile chinook fry and smolts and probably some delay in a portion of the adult migration.

Most natural spawning of UWR chinook salmon takes place in the McKenzie River subbasin. Substrate coarsening has been observed at various places in the McKenzie River basin but evidence regarding whether spawning gravels of adequate quantity and quality are available to UWR chinook salmon under the environmental baseline is inconclusive.

The importance of the upper McKenzie subbasin to UWR chinook salmon spawning and rearing increased throughout the twentieth century as production in the lower subbasin, and in the other five subbasins, dramatically declined. The abundance and quality of spawning and rearing habitat, albeit underseeded, have declined, primarily due to the construction and operation of USACE's Blue River and Cougar dams. Winter flow releases from the dams are much smaller than historical flows at this time of the year due to flood control, and because reservoir filling for summertime recreation begins in February. Thus, side channels of the South Fork and the mainstem downstream of the South Fork confluence that historically provided rearing habitat for fry during the winter are not connected to the main channel (WNF BRRD1994). In the South Fork and the mainstem downstream of the South Fork confluence, the dams create warmer water temperatures during egg incubation in October and November, resulting in fry emergence as early as the first week in December into a longer period of unfavorable winter conditions.

1.4.1.3 Water Quality

The USACE's Cougar and Blue River projects have altered downstream water temperatures in their respective streams and in the mainstem McKenzie downstream to below Leaburg Dam (RM 38; see below). Outflow temperatures have been cooler than inflow in the late spring and summer and warmer than inflow in fall and early winter. In June, the warm water flowing into the lakes floats high above the reservoir outlets. Only the deep, colder water is released. As the reservoirs are drawn down to meet late summer flow objectives at Albany or to create flood control space after the summer recreation season ends, the warmer surface water begins to mix with the remaining cool water. Early storms cause the reservoirs to mix completely by late October or mid-November. Outflow temperature falls through January, followed by a slow warming trend beginning in early spring. The reservoirs begin to stratify during April.

The effect of temperature shifts in the mainstem McKenzie due to USACE operations is moderated by flows originating above Blue River and by the equilibration of stream and ambient air temperatures over 8 miles between the mouth of Blue River and Leaburg Dam (USACE 2000). At Leaburg Dam, EWEB's Leaburg-Walterville Project begins to affect temperature by diverting water from two sections of the lower McKenzie: a 5.8-mile stretch between Leaburg Dam and the point of confluence with the tailrace of the Leaburg powerhouse (Leaburg bypass reach) and a 7.3-mile section between the intake for the Walterville powerhouse and the point of confluence with the Walterville tailrace (Walterville bypass reach). The water temperature model developed during the FERC relicensing process predicted peak temperatures in the bypassed reaches. The model showed that, under a worst-case (hot and dry) climatological scenario, water temperatures can become elevated by 2.7 and 3.6°F (1.5 and 2.0°C) in the lower end of each bypass reach (NMFS 2001).

The ODEQ's 2002 CWA section 303(d) database indicates that temperatures in the South Fork McKenzie below Cougar Dam have exceeded the EPA's recommended maxima for salmonid spawning 55°F (12.8°C) during summer and fall 1991 through 1994. Temperatures in the lower 1.8 miles of Blue River (below the USACE dam) have exceeded the recommended maxima for salmonid spawning 55°F (12.8°C), core migration (61°F;), and non-core rearing and juvenile migration (64°F; 17.8°C). The 2002 database also indicates that the recommended maximum for spawning has also been exceeded in the mainstem McKenzie from RM 0 to RM 54.5 (Finn Rock).

As described in above, cooler water temperatures in the late spring and summer have probably impeded the upstream migration of spring chinook salmon compared to the predevelopment condition. Warmer fall/winter temperatures accelerate egg incubation and fry emergence of spring chinook. These factors may subject salmon fry to unfavorable conditions such as high flows and scarce food, leading to poor survival. The apparent shift to later spawn timing could be a result of selection favoring late-emerging fry (Homolka and Downey 1995).

In a USGS study (Pogue and Anderson 1995), dissolved oxygen concentrations in the lower mainstem McKenzie River (between RM 7.1 and 19.3) attained levels required for salmonid spawning and rearing during both the July and August 1994 sampling periods. The 2002 CWA 303(d) database shows that dissolved oxygen concentrations below ODEQ's numerical criterion for salmonid spawning (i.e., <11.0 mg/L or 95% saturation) were recorded at RM 1.5 in the Mohawk River, an unregulated tributary to the mainstem McKenzie, during October 1 through May 31.

Monk et al. (1975) measured total dissolved gas (TDG) levels of 97.8 to 124.1% saturation near the base of Cougar Dam; 99.5 to 115.7% approximately 3,000 ft downstream; and 103.4 to 108.6% at a site 2.7 miles downstream during November (1970), when yolk sac fry may have been present. Levels measured in March (1971 and 1972) below Blue River Dam ranged from 107.9 to 120.4% saturation. Symptoms of gas bubble trauma have not been reported in juvenile or adult anadromous salmonids in the McKenzie subbasin.

Turbidity is generally very low in the South Fork and mainstem McKenzie rivers; background levels are less than 5 NTU. The USACE began to draw down Cougar Reservoir to prepare for construction of the water temperature control tower during spring 2002. As the reservoir level decreased, the South Fork McKenzie River incised a channel through the sediment delta that had built up at the head of the reservoir over the 30 years since construction. Some of the deltaic sediments remobilized by this process exited Cougar Reservoir in a release of turbid water that lasted from April through July, 2002. The median turbidity measured at USGS Station No. 14159500, approximately ½ mile below the dam, during April 1through June 16, 2002, was 98 NTU, and measurements included a maximum of 379 NTU on April 28, 2002 (USACE 2003). The extended period of elevated turbidity raised questions about potential effects on spawning gravels and macroinvertebrate communities integral to the chinook salmon food web (NOAA Fisheries 2002c).

In response to NOAA Fisheries' request to examine the effects of the sustained turbidity event, USACE contracted with researchers from Oregon State University's Department of Geosciences and the USFS' Pacific Research Station to determine 1) to what extent and depth fine sediments associated with the reservoir drawdown intruded into gravels in the South Fork McKenzie below the dam, and 2) how much of the sediment released from the reservoir traveled in suspension through the McKenzie system and how much had settled out of suspension and was still stored in the subbasin. The first objective was addressed by Stewart et al. (2002), who concluded that there were higher proportions of fine sediments (especially clays) in the gravel bars below Cougar Dam compared to reaches above the reservoir. Clay enrichment was highest immediately below the dam and decreased rapidly downstream; there was no discernable effect of fines from Cougar Reservoir below the confluence of the South Fork and the mainstem McKenzie River. Stewart et al. were unable to determine whether the clay enrichment below the dam occurred during the 2002 reservoir release because there were no pre-drawdown samples for comparison. However, Grant et al. (2002) observed that, after the spring 2002 turbidity events, clouds of sediment were stirred up while wading in the South Fork below Cougar Dam, and to some extent in the mainstem McKenzie, whereas there did not seem to be a surface layer of fine sediment on the gravels above the dam.

One of the Congressionally-authorized purposes of Cougar, Blue River, and the other USACE dams in the Willamette was to reduce water quality problems downstream due in part to nutrient loading (USACE 2000). Cougar and Blue River dams have contributed to the reduced nutrient loads in the lower McKenzie River and upper mainstem Willamette River by increasing summer flows and decreasing summer water temperatures. However, upstream of the dams, the blocking of salmon passage has probably had unanticipated effects on the nutrient cycles of the upper watersheds, particularly with respect to nitrogen. Unlike phosphorus, the volcanic geology of the Cascade Mountains is nitrogen-poor, thus anadromous salmonid carcasses are an important source of imported nitrogen (i.e., marine-derived) in this Cascade portion of the McKenzie subbasin ecosystem (Spence et al. 1996). For example, Triska et al. (1984) found low levels of nitrogen in all forms in a small watershed above Blue River Dam.

While the Blue River watershed above the dam supported a pre-dam annual population of less than 200 UWR chinook salmon spawners (USFWS 1965; WNF BRRD 1996), the South Fork McKenzie watershed above Cougar Dam historically supported an annual population of at least

4,000 UWR chinook spawners (USFWS 1959). Prior to 1958 (no beginning point indicated), an average of approximately 2,000 adult spring chinook salmon entered the South Fork annually to spawn. This average was more than doubled in 1958 when about 4,300 adult spring chinook salmon entered the South Fork. USFWS (1959) calculated that the spawning habitat available in the South Fork at the time would accommodate 5,360 adult spring chinook salmon. Prior to USFWS's study, USACE estimated the South Fork could support a run of 6,000 adult spring chinook salmon, and a 1937-1938 survey by the Bureau of Commercial Fisheries (predecessor of NOAA Fisheries) estimated spawning area available for "at least 13,000 salmon" (WNF BRRD 1994).

The spawner carcasses probably constituted an important source of nitrogen for the stream reaches above the Cougar damsite (and possibly above the Blue River damsite as well), thus the elimination of these carcasses by dam construction reduced nitrogen availability above the dams. This nitrogen limitation is in stark contrast to current nitrogen availability in the lower-elevation areas of the Willamette Basin, where human activities such as application of fertilizers for agriculture has resulted in an overabundance of nitrogen and other nutrients in aquatic environments (USGS 1995, 1996). This simultaneous nutrient impoverishment (highlands) and nutrient enrichment (lowlands) due to human activities is commonly observed at the subbasin and basin scales (Stockner et al. 2000).

The ODEQ's 2002 CWA section 303(d) database does not indicate that any streams in the McKenzie subbasin are water quality limited due to excess nutrients or toxics.

1.4.1.4 Status of the Baseline

Table 1 summarizes the factors relevant to the status of the environmental baseline in the action area, based on the *Matrix of Pathways and Indicators* (MPI) described in NMFS (1996).

Table 1. Status of the environmental baseline within the action area, as defined by NOAA Fisheries' Matrix of Pathways and Indicators (NMFS 1996, 1999).

PFC Pathway	PFC Indicator	Properly Functioning Conditions	Current Baseline Conditions in the Action Area	Status
Water Quality	Temperature	ODEQ criterion: Rearing- 17.8ºC	Cooler water temperatures in the late spring and summer probably impeded upstream migration of spring chinook salmon; warmer fall/winter temperatures accelerated egg incubation and fry emergence. ODEQ 2002 CWA 303(d) database indicates that temperatures in the South Fork below Cougar Dam have exceeded recommended maxima for salmonid spawning during summer and fall. Temperatures in the lower 1.8 miles of Blue River have exceeded recommended maxima for salmonid spawning, core migration, and non-core rearing and juvenile migration. Temperatures in the mainstem McKenzie from RM 0 to 54.5 have exceeded the recommended maximum for spawning. Recommended maxima for core rearing and non-core rearing and juvenile migration have been recorded in tributaries: Deer Creek, and the Mohawk River.	NPF
	Sediment/Turbidity	low turbidity	Background turbidity levels are generally very low in the South Fork and mainstem McKenzie rivers. Release of turbid water during the spring 2002 drawdown of Cougar Reservoir for construction of the water temperature control tower resulted in elevated turbidity levels, including a maximum of 379 NTU. After this event, there were higher proportions of fine sediments (especially clays) in the gravel bars below Cougar Dam compared to reaches above the reservoir.	At risk
	Total dissolved gas	TDG not exceed 120% of saturation in the tailrace where the water is deeper than 13 ft	TDG levels of 97.8 to 124.1% saturation near the base of Cougar Dam; 99.5 to 115.7% approximately 3,000 ft downstream; and 103.4 to 108.6% at a site 2.7 miles downstream during November (1970), when yolk sac fry may have been present. TDG levels of 107.9 to 120.4% saturation in March (1971 and 1972) below Blue River Dam. Symptoms of gas bubble trauma have not been reported in juvenile or adult anadromous salmonids in the McKenzie subbasin.	At risk

	Chemical/nutrient Contamination	Low levels of chemical contamination from agricultural, industrial, and other sources; no excess nutrients; no CWA 303(d) designated reaches	Blue River and Cougar Dams have cut off a source of nutrients (chinook carcasses) in upper parts of the system. ODEQ 2002 CWA 303(d) database does not indicate that any streams in the McKenzie subbasin are water quality limited due to excess nutrients. ODFW has released adults from excess hatchery stock above Cougar Reservoir to provide for missing carcasses.	At risk
Habitat Access	Physical barriers	Any man-made barriers present in the watershed allow upstream and downstream passage at all flows	Cougar reservoir and Carmen-smith block access. EWEB projects have altered migration conditions in the mainstem McKenzie River by creating barriers to migration. This is in the process of being rectified. Migration conditions will improve in next few years. These projects are identified in NMFS 2001. Currently, trap facilities at Leaburg Dam require excessive handling of adult chinook. The trap facility is not adequately designed and may cause injury/mortality of adult fish. This trap is not addressed by NMFS 2001 and is the responsibility of the USACE and ODFW..	NPF
Habitat Elements	Substrate	Dominant substrate is gravel or cobble (interstitial spaces clear) or embeddedness <20%	Substrate has coarsened in the mainstem McKenzie downstream of Cougar and Blue River Dams. South Fork McKenzie River downstream of Cougar reservoir has stabilized Current sediment budget not creating and maintaining habitat needed by anadromous salmonids.	At risk

	Large wood	>80 pieces per mile and adequate source of large wood recruitment	The upper McKenzie, below Trailbridge Dam is deprived of large wood, although some restoration efforts have begun. The South Fork McKenzie below Cougar Dam, and Blue River Dam are deprived of large wood from the headwaters. The McKenzie river below Cougar and Blue River dams is deprived of large wood from the South Fork and Blue River. Inadequate recruitment of large wood from riparian areas along mainstem McKenzie and tributaries downstream from Cougar and Blue River dams. Lack of large wood-associated habitat for anadromous salmonids and invertebrates upon which they feed.	NPF
	Pool Frequency		19% reduction of large pools in the McKenzie from RM 24 to RM 82, including an 85% reduction in the 15 RM downstream of Leaburg Dam.	NPF
	Pool quality	>1m deep	19% reduction of large pools in the McKenzie from RM 24 to RM 82, including an 85% reduction in the 15 RM downstream of Leaburg Dam.	NPF
	Off-channel habitat	Backwaters with cover, and low-energy off-channel areas	Significant reductions in length of side channels.	NPF
	Refugia	Habitat refugia exist and are adequately buffered; existing refugia are sufficient in size, number, and connectivity to maintain viable populations or subpopulations	Some refugia exist in the action area reach, but they are neither large nor high-quality.	At risk
Channel Conditions and Dynamics	Streambank condition	>90% stable due to presence of riparian vegetation, erosion and deposition processes are in a state of dynamic equilibrium.	Up to 13% of banks in the McKenzie River are riprapped (MWC 2000)	At Risk
	Floodplain Connectivity	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland function, riparian vegetation, and succession.	Some exists, but has been significantly reduced by USACE flood control operations.	At risk
Flow/ hydrology	Change in Peak/Base flows	Watershed hydrograph indicates peak flow, base flow, and flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography	USACE flood control projects have significantly altered both pak and base flows.	NPF

Watershed Conditions	Road Location	River mechanics affected by road location	Highway 126 constrains the river within the action area.	NPF
	Disturbance history	Land-clearing and development activities have not significantly altered hydrologic and natural contaminant filtration processes (e.g. infiltration, run-off rates, etc.)	Disturbance regime is dominated by timber harvesting Forests are dominated by early- to mid-successional stages, with some late-successional forests in wilderness areas in the Horse Creek and South Fork subwatersheds timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat Upper watershed is forested, but some is managed for timber production rather than ecosystem health Lower watershed contains extensive agricultural, urban, and residential development	NPF
	Riparian Reserves	The riparian reserve system provides adequate shade, large wood recruitment, and habitat protection and connectivity in all watershed	Two-thirds of land parcels next to the river are developed rural properties. Natural vegetation has been disturbed at 85% of these properties (MWC 2000). The acreage covered and functional value of riparian vegetation of the McKenzie subbasin has been greatly reduced during the 20^{th} century	NPF

Based on the information above, many of the habitat and biological requirement of UWR chinook salmon in the action area are not being met under the environmental baseline. Any further degradation or delay in improving these conditions might increase the amount of risk that the listed ESUs presently face. The status of these species are such that there must be a significant improvement in the biological and habitat conditions they have experienced under the environmental baseline to meet their biological requirements for survival and recovery.

1.5 Effects of the Proposed Action

In step 3 of the jeopardy analysis, NOAA Fisheries evaluates the effects of proposed actions on listed species and seeks to answer the question of whether the species can be expected to survive with an adequate potential for recovery if those actions go forward. There is more than one analytical framework for determining an activity's effect, and NOAA Fisheries will consider any scientifically credible analysis. In order to streamline the consultation process and to lead to more consistent effects determinations across agencies, NOAA Fisheries recommends use of the MPI and procedures in NMFS (1996) to make effects' determinations. Regardless of the analytical method used, if a proposed action is likely to impair properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it cannot be found consistent with conserving the species.

The biological assessment provides an analysis of the effects of the proposed action on UWR chinook salmon and their habitat in the action area. Potential direct effects include: 1) mortality or injury of fish during cofferdam construction, dewatering of the cofferdammed area, and salvage of fish from the dewatered area; 2) harm and harrassment to fish downstream from the project area caused by suspended sediment and turbidity associated with installation and removal of the cofferdam; 3) mortality or injury to fish from potential release of chemical contaminants or hazardous material (gasoline, oil, grease, concrete, etc.) entering the river in an unexpected spill; and 4) temporary and permanent loss of wetland and riparian habitat.

1.5.1 Mortality or Injury of Fish During Cofferdam Construction, Dewatering and Salvage

The in-river construction of the cofferdams will take place during June 30-July 11, 2003, which is outside the reported period for peak downstream migration of chinook salmon. Naturally-produced fry migrate past Leaburg Dam from December-May, with peak migrations occurring in February and March (FERC 1996). Young-of-the-year chinook salmon pass Leaburg Dam in low numbers throughout the year with peak migrations occurring in October and November (EA 1991). However, chinook salmon usually exhibit seasonal variations in run timing resulting from varying environmental conditions and individuals can migrate outside peak migration periods. Thus, juvenile chinook salmon could be present in the vicinity of the cofferdam. The in-river construction of the cofferdam for the tailrace barrier will occur during the period of upstream migration for adult chinook salmon. As described in Section 1.3.1.3, UWR chinook salmon enter the McKenzie River beginning in April and spawn from August to early November. Thus, adult chinook salmon could be present in the vicinity of the cofferdam.

In the Leaburg Canal, there is a risk of direct mechanical injury of juvenile UWR chinook during cofferdam construction because it will be constructed under flowing water conditions. UWR chinook also may encounter equipment during in-river work at the Leaburg tailrace. This risk is expected to be low to be low in both cases, as both juvenile and adults should avoid equipment in the water and the period of construction is outside reported peak downstream migration periods for juvenile UWR chinook salmon. Direct injury of fish during cofferdam removal is expected to be low.

Initially the head gates at the upstream end of the Leaburg Canal will be partially closed, which will decrease the surface elevation of the power canal by approximately 1 ft per day. When the canal reaches elevation 734.5, the headgates will be adjusted to maintain a flow of approximately 50 cfs in the canal. The canal will be held at or below elevation 734.5 and with a flow of approximately 50 cfs for a maximum of 24 hours to allow construction of the cofferdam. At the completion of this period, the temporary water supply system will be fully operational. The area of the power canal immediately downstream of the cofferdam will dewater by gravity flow until the temporary water supply system is operational. Once the cofferdam is constructed and the temporary water supply is functional, screened pumps will be used to completely dewater the construction zone between the head gates and the cofferdam. The tailrace also will be dewatered as the intake is closed. The pump screening will meet NOAA Fisheries criteria during dewatering at both sites.

The proposed modifications to the Leaburg screen facility and construction of the tailrace barrier consist of several components. Most of the proposed construction activities require dewatering of a section of the Leaburg Canal and the Leaburg tailrace. In accordance with FERC license article 422, EWEB developed a detailed Fish Salvage Plan that was approved by ODFW on April 16, 2002, and submitted to FERC on April 17, 2002. This Fish Salvage Plan was instituted during the construction of the Walterville Projects in 2002. The procedures and methods for salvaging fish from the Walterville Canal in 2002 will be used to salvage fish from the Leaburg screen facility. As the water level in the power canal drops, fish will be rescued and relocated by implementing the precautionary measures proposed by EWEB (as listed in Section 1.2.2) and the ODFW-approved Fish Salvage Plan for the Walterville Canal. These guidelines were developed to minimize, to the maximum extent possible, harm to listed fish during capture, handling, and transport. The procedures use benign techniques for rescue of entrapped fish (use of NMFS criteria fish screens for dewatering pumps, use of experienced staff, use of sanctuary nets that hold water during transfer, and release of fish in the vicinity of the capture site (EWEB 2002)). However, with all fish salvage operations some direct mortality of fish is expected from handling stress. Handling mortality will be minimized by using trained personnel to conduct all fish salvage operations. Effects of isolating the work area from the flowing waters of the McKenzie River could result in minor incidental take of UWR chinook salmon, including the lethal take of a small number of juveniles. EWEB estimates, based upon the experience in 2002 at Walterville and site-specific habitat and flow conditions, up to 1500 juveniles and 25 adult chinook salmon could be captured and released. Lethal take of juveniles should be less than 5% (approximately 75) (Downey 2003). This estimate and compares well with the results from salvage of the Walterville canal in 2002. In 2002, EWEB rescued 10,356 wild chinook salmon fry (age 0+) from the Walterville canal, and 25 wild chinook salmon smolts. The mortality rate of age 0+ fish was 1.6% (170 fish), with no known mortality of smolts. EWEB estimated its capture efficiency at 95% for the Walterville project, resulting in an estimated 500 juveniles that were not recovered and likely perished in isolated pools remaining in the canal as water temperatures increased over the summer. All live juvenile chinook salmon were released into the McKenzie River (pers. comm., Tim Downey, EWEB, Eugene, Or). Due to the substantially reduced area proposed for salvage and that the area being salvaged is less diverse, we expect that the capture efficiency will increase during this salvage operation.

In summary, juvenile and adult UWR chinook presence in the vicinity of the construction activity is expected to be low due to timing of installation and removal of the cofferdam. The natural tendency of UWR chinook to avoid this type of activity is expected. This coupled with the benign techniques proposed for salvage of UWR chinook is expected to result in minimal effects to UWR chinook.

1.5.2 Harm and Harrassment to Fish Downstream From the Project Area Caused by Suspended Sediment and Turbidity Associated with Installation and Removal of the Cofferdam

Installation, construction, and removal of the cofferdam may dislodge fine particles in the existing bed material of the Leaburg Canal and the river and increase suspended sediment levels (turbidity) in waters downstream of the construction site. This increase in turbidity will result in temporary and minor negative effects on fish habitat and could result in direct injury or mortality to fish present in the project area. This increase in turbidity is likely to occur at two different times within the duration of the proposed project (during installation in early July and again during removal in December). UWR chinook spawn in this McKenzie River subbasin from August through November, adult passage occurs February through June and juvenile salmonids outmigrate in the spring. The installation of the cofferdams is proposed for early July and removal is proposed for December.

The effects of suspended sediment and turbidity on fish are reported in the literature as ranging from beneficial to detrimental (see below). Elevated total suspended solids (TSS) conditions have been reported to enhance cover conditions, reduce piscivorous fish/bird predation rates, and improve survival. Elevated TSS conditions have also been reported to cause physiological stress, reduce growth, and adversely affect survival. Of key importance in considering the detrimental effects of TSS on fish are the season, frequency, and duration of the exposure (not only the TSS concentration).

Behavioral avoidance of turbid waters may be one of the most important effects of suspended sediments (DeVore et al. 1980; Birtwell et al. 1984; Scannell 1988). Salmonids have been observed to move laterally and downstream to avoid turbid plumes (McLeay et al. 1984, 1987; Sigler et al. 1984; Lloyd 1987; Scannell 1988; Servizi and Martens 1991). Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities, except when the fish need to traverse these streams along migration routes (Lloyd et al. 1987). Gregory and Levings (1988) reported that turbidity also provides refuge and cover from piscivorous fish and birds. In systems with intense predation pressure, this benefit (i.e., enhanced survival) may balance the cost of detrimental physical effects (i.e., reduced growth). Turbidity levels of about 23 NTU have been found to minimize predation risk (Gregory 1993).

Exposure duration is a critical determinant of the occurrence and magnitude of physical or behavioral effects (Newcombe and MacDonald 1991). Salmonids have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with flood events, and are adapted to such high pulse exposures. Adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that occur during storm and snowmelt runoff episodes (Bjornn and Reiser 1991).

However, research indicates that chronic exposure can cause physiological stress responses that can increase maintenance energy and reduce feeding and growth (Redding et al. 1987; Lloyd 1987; Servizi and Martens 1991).

At moderate levels, turbidity has the potential to adversely affect primary and secondary productivity, and at high levels, has the potential to injure and kill adult and juvenile fish. Turbidity might also interfere with feeding (Spence et al. 1996). Newly emerged salmonid fry may be vulnerable to even moderate amounts of turbidity (Bjornn and Reiser 1991). Other behavioral effects on fish, such as gill flaring and feeding changes, have been observed in response to pulses of suspended sediment (Berg and Northcote 1985). Fine redeposited sediments also have the potential to adversely affect primary and secondary productivity (Spence et al. 1996), to reduce incubation success (Bell 1991), and to reduce cover for juvenile salmonids (Bjornn and Reiser 1991).

It is expected that the majority of suspended sediment will settle out downstream of the cofferdam construction site in the canal prior to reaching the Leaburg forebay and powerhouse. The length of power canal required for sediment deposition downstream of the cofferdam is not known. Fine suspended sediment typically settles out in areas of lowest velocity, such as pockets, backwaters, and pools. Low water depths in the canal resulting from minimum flows will likely exacerbate turbid conditions that may result from installation of the cofferdam or discharge of dewatering effluent from the construction zone. Fish present in the Leaburg Canal downstream of the cofferdam may be subject to an increase in turbid water. Even though fish in the Leaburg Canal may be exposed to increased levels of suspended sediments. However, fish should avoid the construction zone by using less-turbid areas in downstream portions of the power canal.

Since the existing screens will be operational during cofferdam construction, and sedimentation will occur downstream of the construction activities, it is likely that juvenile chinook migrating through the work area will be bypassed during cofferdam construction and will not be exposed to high turbidity. Given the fact that the work will occur after the peak spawning period for chinook salmon and that EWEB's Proposed Measures will minimize the amounts of suspended sediment that will enter the canal, the likelihood that suspended sediment will affect UWR chinook salmon is small.

UWR chinook spawn from August to November in this subbasin, remain buried for 1 to 4 months after spawning and can remain in the gravel 1 to 3 weeks. Spawning ground flights conducted by EWEB and ODFW indicate that chinook salmon have spawned in the Leaburg tailrace; five redds were found in the tailrace in 2002. Chinook salmon also spawn in the mainstem McKenzie River downstream of the tailrace; however, the vast majority of chinook salmon spawning occurs upstream of Leaburg Dam. Most of the spawning downstream of Leaburg Dam is by hatchery fish. Even in the reach below Leaburg Dam the majority of spawning occurs upstream of the tailrace. For example, in 2002 the nearest redds (in the mainstem McKenzie) were located 2.5 miles downstream and only 25 redds were counted within 5 miles downstream of the tailrace (64 total redds were counted between the tailrace at RM 33.1 and the mouth of the McKenzie River). In comparison, 139 redds were found within 6 miles upstream of the tailrace, but below Leaburg Dam (EWEB 2003).

It is unlikely that suspended sediment will settle out directly at the cofferdam construction site due to high water velocity in mainstem McKenzie River adjacent to the tailrace. However, suspended sediment has the potential to settle out on top of the existing bed material further downstream, possibly affecting the quality of spawning and rearing habitat. Fine suspended sediment typically settles out in areas of lowest velocity, such as pockets, backwaters, and pools. Since chinook salmon spawn in water with velocities between 30 and 91 cm/second (Bjornn and Reiser 1991), it is unlikely that spawning areas will experience any significant sedimentation. Given the fact that the majority of chinook salmon spawning occurs upstream of the tailrace and that EWEB's Proposed Measures will minimize the risk that suspended sediment will enter the river, the likelihood that suspended sediment affecting spawning chinook salmon habitat is small.

In summary, there is a small risk of injury and mortality associated with turbidity from construction and removal of the cofferdams. However, these impacts should not significantly affect long-term habitat processes or population levels, because the turbidity should be localized, brief, and timed to occur within a period that minimizes effects on UWR chinook salmon. The turbidity levels that could be expected from this project are not likely retard the long-term progress of impaired habitats towards recovery.

1.5.3 Effects of Potential Release of Chemical Contaminants or Hazardous Materials

Operation of construction machinery in, and in close proximity to, the canal introduces a chance for toxic contaminants to enter the canal. Pollutants can be introduced into waterbodies through direct contact with contaminated surfaces or by the introduction of storm or washwater runoff and can remain in solution in the water column or deposit on the existing bed material. Research has shown that exposure to contaminants reduces reproductive capacity, growth rates, and resistance to disease, and may lead to lower survival for salmon (Arkoosh 1998 a, 1998b).

In summary, EWEB's Proposed Measures include numerous measures for reducing the likelihood that pollutants will enter the power canal. Implementation of a PECP is included in EWEB's Proposed Measures. FERC license article 401 requires that EWEB submit a PECP, including a Spill Containment and Control Plan, prior to construction. The PECP for the Walterville Project was submitted to FERC on April 2, 2002, and received NOAA Fisheries' approval by letter dated March 22, 2002. The elements of the PECP for the Walterville Project will also be applied to the Leaburg screen facility construction project. Specific measures for reducing the impacts of turbidity and pollutants are included in the Proposed Measures listed previously and include: a.vi. Treated Wood Removal, b. Pre-construction Activities, c. Heavy

Equipment, and d. Site Preparation. The likelihood that contaminants will enter waterways will be very low by implementation and enforcement of the PECP and the details listed in the Proposed Measures section of this report. This coupled with the low abundance of juvenile UWR chinook and some ability of adults to avoid contaminated areas, should result in little to no effect of this part of the proposed action on UWR chinook.

1.5.4 Temporary and Permanent Loss of Wetland and Riparian Habitat

Riparian habitats are one of the most ecologically productive and diverse terrestrial environments. Vegetation in wetland and riparian areas influences channel processes by stabilizing bank lines through root reinforcement, providing a source of large wood, and by retaining sediment during high-flow events. Riparian areas provide energy sources for aquatic organisms by producing organic input (e.g., leaf litter) and terrestrial organisms that fall into the water and are preyed upon by fish. Riparian vegetation provides shade that regulates light and temperature regimes (Naimen and Decamps 1997; Naiman et al. 1993). In addition, riparian vegetation and large wood can provide low velocity habitat for fish during periods of flooding, while instream large wood provides similar habitat, as well as shelter from predators, habitat for prey species, and sediment storage and channel stability attributes (Spence et al. 1996). This habitat will be impacted by the proposed construction of the fish facilities and access roads. EWEB has proposed that any instream large wood or riparian vegetation that is moved or altered by construction activities will stay on-site or be replaced with a functional equivalent in accordance with EWEB's Proposed Measures. EWEB is also requiring the contractor recontour and replant all affected areas with native woody and herbaceous vegetation after construction in accordance with EWEB's Proposed Measures. Success of replanting efforts will be assured by implementation and enforcement of EWEB's Proposed Measures regarding planting success (EWEB 2003).

Creation of new access roads for construction and long term maintenance of each facility has been minimized. The west side of Leaburg fish screens will be accessed from Highway 126 into an existing graveled parking lot (adjacent to the west side of the fishscreen structure). The east side of the fish screens will be accessed from an existing county road and EWEB canal roads. The tailrace barrier will be accessed (both on the east and west sides) from Highway 126 through an existing housing area, which is already graveled. Access to the west side of the tailrace through a temporary access road, which will be reseeded and replanted following construction. The east side of the tailrace will be accessed through a new permanent access road (lengthening the existing road by 250 feet) (Jossis 2003).

The estimated land area subject to temporary impact during modifications to the fish screen and bypass systems includes the staging area (approximately 16,200 square ft) and clearing around the existing pedestrian bridge (approximately 90 square ft on each side of the canal). The estimated area of existing canal (in water) that will be temporarily impacted equals approximately 78,600 square ft. The estimated land area of permanent impact includes the right and left banks of canal immediately upstream of the existing fish screens (approximately 560 square ft). The estimated area of Leaburg Canal (in water) that will be permanently impacted equals approximately 600 square ft. Much of Leaburg canal has recently been cleared to satisfy safety issues on the canal, so the temporary effect of lowering the water table will likely not result in additional damage to canal vegetation.

The estimated land area subject to temporary impact during construction of the tailrace barrier includes the staging area (approximately 9600 square ft) and a clearing around the existing access road (approximately 15,000 square ft). The estimated land area of permanent impact includes the right bank of tailrace (approximately 42,500 square ft) and a new access road and left bank of tailrace clearing (approximately 27,400 square ft). The estimated area of existing tailrace canal (in water) that will be permanently impacted equals approximately 57,000 square ft. The estimated area of existing canal (in water) that will be temporarily impacted equals approximately 115,000 square ft (assuming all areas from the cofferdam up the tailrace canal to the powerhouse).

Approximately 148 trees over 3 inches DBH will be removed during construction of the tailrace barrier and modifications to the fish screen/bypass system. Any trees greater than 3 inches in diameter that are removed will be mitigated for on-site with a 2:1 replanting ratio in accordance with EWEB's Proposed Measures. Any riparian areas that are temporarily altered during construction will be revegetated with native woody and herbaceous vegetation in accordance with EWEB's Proposed Measures. Temporarily disturbed areas will also be stabilized by hydroseeding.

1.5.5 Summary of Project Effects

Table 2 describes the expected type and duration of effects of the proposed action on the environmental baseline. A pulse effect is one which will have temporary effects that will be relaxed almost immediately upon cessation of construction, while press effects will persist for at least several years before relaxing.

Table 2. Summary of effects of the proposed action on UWR chinook salmon and the environmental baseline.

PFC Pathway	PFC Indicator	Baseline Condition	Proposed Action Affecting Baseline Condition	Type and Duration of Effect	Probability of effect occurring	Effects on Baseline
Water Quality	Temperature	NPF	The proposed action is not expected to affect water temperature.	none		Maintain
	Sediment/ Turbidity	At Risk	In-water work necessary to excavate, construct and access the cofferdam will likely increase turbidity and suspended sediment within the action area.	Pulse- effect will likely cease upon construction. Any sediment that settled downstream of the project will be flushed out in the first storm event. This turbidity should be removed prior to the peak of spawning activity.	likely	Maintain
	Total dissolved gas	At risk	The proposal is not expected to affect TDG levels.	None		Maintain
	Chemical Nutrient Contamination	At risk	Chemical pollutants from construction equipment could leak into the creek during in-water work or from the staging area. Implementation of the PECP and supplemental inspections make minimal the likelihood of this occurring.	Pulse- If an event occurs, implementation of erosion control and spill containment measures will minimize the duration and intensity of this effect.	unlikely, but possible	Maintain
Habitat Access	Physical Barriers	NPF	Passage through the project area will be maintained throughout construction, with the possible exception of short term avoidance reducing passage.	Pulse - any reduction in passage during construction would be localized and short term.	unlikely	maintain
Habitat Elements	Substrate	At risk	Excavation and regrading will redistribute substrate within the action area.	None		maintain
	Large Wood	NPF	The proposed action is not expected to affect large wood within the action area.	N/A	N/A	Maintain
	Pool Frequency	NPF	The proposed action is not expected to affect pool frequency within the action area.	N/A	N/A	Maintain
	Pool quality	NPF	The proposed action is not expected to affect pool quality within the action area.	N/A	N/A	Maintain
	Off-channel habitat	NPF	The proposed action is not expected to affect off-channel habitat within the action area.	N/A	N/A	Maintain

	Refugia	At risk	The proposed action is not expected to affect refugia within the action area.	N/A	N/A	Maintain
	Streambank condition	At risk	The proposed action is not expected to significantly change streambank condition within the action area.	N/A	N/A	Maintain
	Floodplain connectivity	At risk	The proposed action is not expected to change floodplain connectivity within the action area.	N/A	N/A	Maintain
Flow/ Hydrology	Change in Peak/Base flows	NPF	The proposed action is not expected to change peak or base flows within the action area.	N/A	N/A	Maintain
Watershed Conditions	Road Density and Location	NPF	The proposed action is not expected to change road density and location within the action area.	N/A	N/A	Maintain
	Disturbance History	NPF	The proposed action is not expected to change disturbance history within the action area.	N/A	N/A	Maintain
	Riparian Reserves	NPF	Any vegetation removed during the construction process will be replanted with native vegetation, so there could be a slight increase in riparian habitat quality.	N/A	N/A	Maintain

In summary, NOAA Fisheries expects temporary increases in suspended sediment/turbidity to result from in-water work associated with the proposed action. Operating machinery in and near the stream introduces risks of chemical pollutants entering the waterway. NOAA Fisheries expects that these effects are either very unlikely to occur or, if they do, they will be localized and will subside upon completion of construction. There is also a risk of direct harm to UWR chinook salmon due to operation of machinery in the river and during the capture and release effort behind the cofferdam. The likelihood that few UWR chinook juveniles will be in the action area and the ability of UWR chinook adults to avoid most areas of disturbance indicate that these activities will have a minor effect on UWR chinook. Additionally, EWEB has proposed numerous conservation measures, which are part of USACE's proposed action, to minimize these risks. Finally, because the tailrace barrier will enhance passage conditions, the project is necessary to implement the improved passage conditions addressed in NMFS and USFWS 2001.

1.5.6 Cumulative Effects

Cumulative effects, as defined in 50 CFR Section 402.02, include the effects of future state, tribal, local, or private actions, not involving Federal activities, that are reasonably certain to occur within the action area (described in Section 1). Future Federal actions requiring separate consultations pursuant to Section 7 of the ESA are not considered here.

State, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives. Government and private actions may include changes in land and water use patterns, including ownership and intensity, any of which could affect listed species or their habitat. Even actions that are already authorized are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope of the action area, which encompasses numerous government entities exercising various authorities and many private landholdings, make any analysis of cumulative effects difficult and even speculative. This section identifies representative actions that, based on currently available information, are reasonably certain to occur. It also identifies goals, objectives and proposed plans by state and tribal governments, however, NOAA Fisheries is unable to determine at this point in time whether such proposals will in fact result in specific actions.

1.5.6.1 State Actions

Most future actions by the state of Oregon are described in the Oregon Plan for Salmon and Watershed measures, which includes the following programs designed to benefit salmon and watershed health:

1. Oregon Department of Agriculture water quality management plans.
2. Oregon Department of Environmental Quality development of total maximum daily loads (TMDLs) in targeted basins; implementation of water quality standards.
3. Oregon Watershed Enhancement Board funding programs for watershed enhancement programs, and land and water acquisitions.
4. ODFW and Oregon Water Resources Department (OWRD) programs to enhance flow restoration
5. OWRD programs to diminish overappropriation of water sources.
6. ODFW and Oregon Department of Transportation programs to improve fish passage; culvert improvements/replacements.
7. Oregon Department of Forestry state forest habitat improvement policies and the Board of Forestry pending rules addressing forestry effects on water quality and riparian areas.
8. Oregon Division of State Lands and Oregon Parks Department programs to improve habitat health on state-owned lands.
9. Department of Geology and Mineral Industries program to reduce sediment runoff from mine sites.
10. State agencies funding local and private habitat initiatives; technical assistance for establishing riparian corridors; and TMDLs.

If the foregoing programs are implemented, they may improve habitat features considered important for the listed species. In November 2000, however, Oregon voters approved a broad constitutional amendment requiring payment to private property owners for diminution in property values resulting from regulations. That measure essentially puts all Oregon regulatory initiatives into question. The Oregon Plan also identifies private and public cooperative programs for improving the environment for listed species. The success and effects of such programs will depend on the continued interest and cooperation of the parties. One such cooperative program, the Willamette Restoration Initiative (WRI), has been charged with developing the Willamette basin section of the Oregon Plan. The future of the WRI will be subject to discussion among the WRI board, the Oregon Governor's office, and the Oregon legislature in the 2001 legislative session.

In the past, Oregon's economy has depended on natural resources, with intense resource extraction. Changes in the state's economy have occurred in the last decade and are likely to continue, with less large-scale resource extraction, more targeted extraction, and significant growth in other economic sectors. Growth in new businesses, primarily in the technology sector, is creating urbanization pressures and increased demands for buildable land, electricity, water supplies, waste-disposal sites, and other infrastructure.

Economic diversification has contributed to population growth and movement in the Willamette Valley, a trend likely to continue for the next few decades. Such population trends will result in greater overall and localized demands for electricity, water, and buildable land in the action area; will affect water quality directly and indirectly; and will increase the need for transportation, communication, and other infrastructure. The impacts associated with these economic and population demands will probably affect habitat features such as water quality and quantity, which are important to the survival and recovery of the listed species. The overall effect will be negative, unless carefully planned for and mitigated.

Some of the state programs described above are designed to address these impacts. Oregon also has a statewide, land-use-planning program that sets goals for growth management and natural resource protection. If the programs continue, they may help lessen the potential for the adverse effects discussed above.

1.5.6.2 Local Actions

Local governments will be faced with similar and more direct pressures from population growth and movement. There will be demands for intensified development in rural areas, as well as increased demands for water, municipal infrastructure, and other resources. The reaction of local governments to growth and population pressure is difficult to assess without certainty in policy and funding. In the past, local governments in Oregon generally accommodated growth in ways that adversely affected listed fish habitat. Because there is little consistency among local governments regarding current ways of dealing with land use and environmental issues, both positive and negative effects on listed species and their habitat are probably scattered throughout the action area.

Local governments in Oregon are considering ordinances to address effects on aquatic and fish habitat from different land uses. The programs are part of state planning structures; however, local governments are likely to be cautious about implementing new programs, because of the passage of the constitutional amendment discussed above. Some local government programs, if submitted, may qualify for a limit under NOAA Fisheries' 4(d) rule, which is designed to conserve listed species. Local governments may also participate in regional watershed health programs, although political will and funding will determine participation and, therefore, the effect of such actions on listed species. Overall, unless beneficial programs are comprehensive, cohesive, and sustained in their application, it is not likely that local actions will have measurable positive effects on listed species and their habitat and may even contribute to further degradation.

1.5.6.3 Tribal Actions

Tribal governments will participate in cooperative efforts involving watershed and basin planning designed to improve aquatic and fish habitat. The results of changes in tribal forest and agricultural practices, in water resource allocation, and in land use are difficult to assess. The tribal governments have to apply and sustain comprehensive and beneficial natural resource programs, to areas under their jurisdiction to have measurable positive effects on listed species and their habitat.

NOAA Fisheries knows of no ongoing tribal fisheries restoration project in the McKenzie River basin.

1.5.6.4 Private Actions

The effects of private actions are the most uncertain. Private landowners may convert their lands from current uses, or they may intensify or diminish those uses. Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or they may result from growth and economic pressures. Changes in ownership patterns will have unknown impacts. Whether any of these private actions will occur is highly unpredictable, and the effects are even more so.

1.5.6.5 Summary

Non-Federal actions are likely to continue affecting listed species. The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape covered by this opinion, the geographic and political variation in the action area, the uncertainties associated with government and private actions, and ongoing changes to the region's economy. Whether those effects will increase or decrease in the future is a matter of speculation; however, based on the population and growth trends identified in this section, cumulative effects are likely to increase. Although state, tribal, and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive manner before the NOAA Fisheries can consider them "reasonably foreseeable" in the analysis of cumulative effects.

1.6 Conclusion

NOAA Fisheries has determined, based on the available information, that the proposed action covered in this biological opinion is not likely to jeopardize the continued existence of UWR chinook salmon. NOAA Fisheries used the best available scientific and commercial data to apply its jeopardy analysis, analyzing the effects of the proposed action on the biological requirements of the species relative to the environmental baseline, together with cumulative effects. This finding is based, in part, on:

- The likelihood that few juvenile UWR chinook will be in the action area during construction.
- The ability of UWR chinook adults to avoid mechanical injuries associated with in-water work.
- Salvage operations that use the best available methods for handling juvenile and adults with little to no injury or mortality.
- Expected behavioral avoidance of any project caused turbidity, an expectation that any deposited sediment will be washed out with the first storm, and the presence of most spawning habitat is upstream of the construction area.
- Small likelihood of chemical contamination because of PECP previously approved by NMFS, consulted upon in NOAA Fisheries (2002a and 2002b), and successfully implemented in 2002 by EWEB.
- A plan to revegetate much of the disturbed streambank, including replacing large wood and planting twice as many trees as removed.
- The permanently modified habitat makes up an extremely small percentage of the action area and the modifications are necessary to implement the passage improvements already required in NMFS and USFWS (2001).

NOAA Fisheries believes that most construction-related adverse effects will be temporary and that the proposed action is necessary to improve long-term passage conditions for listed species in the McKenzie River watershed, as determined in NMFS and USFWS (2001).

1.7 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NOAA Fisheries did not identify any conservation recommendations in this biological opinion.

1.8 Reinitiation of Consultation

This concludes formal consultation on these actions in accordance with 50 CFR 402.14(b)(1). As provided in 50 CFR 402.16, reinitiation of consultation is required: 1) if the amount or extent of incidental take is exceeded, 2) if the action is modified in a way that causes an effect on the listed species that was not previously considered in the BA and this biological opinion, 3) if new information or project monitoring reveals effects of the action that may affect the listed species in a way not previously considered, or 4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

2. INCIDENTAL TAKE STATEMENT

Section 9 and rules promulgated under Section 4(d) of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, and sheltering. Harass is defined as actions that create the likelihood of injuring listed species by annoying it to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the impact of any incidental taking of threatened species. It also provides reasonable and prudent measures (RPM) that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the RPMs.

2.1 Amount or Extent of the Take

NOAA Fisheries anticipates that the proposed action is reasonably certain to result in incidental take of UWR chinook salmon because of the detrimental effects from the capture and release of fish within the in-water work area (non-lethal and lethal), disturbance due to in-water work (non-lethal), and increased sediment and possible pollutant levels (non-lethal).

Effects of actions such as the one covered by this biological opinion are largely unquantifiable in the short term, and are not expected to be measurable as long-term effects on habitat or population levels. Therefore, even though NOAA Fisheries expects some low level incidental take to occur due to the construction actions covered by this biological opinion (other than fish capture and release), the best scientific and commercial data available are not sufficient to enable NOAA Fisheries to estimate a specific amount of total incidental take to the species itself. In instances such as these, NOAA Fisheries designates the expected level of take as "unquantifiable."

Effects of isolating the work area from the flowing waters of the McKenzie River could result in minor incidental take of UWR chinook salmon, including the lethal take of a small number of juveniles (this effect is quantifiable). Based on site-specific habitat and flow conditions, up to 1500 juveniles and 25 adult chinook salmon could be captured and released. Lethal take of juveniles should be less than 5% (approximately 75), with no mortality of adult UWR chinook salmon expected, due to implementation of the handling protocols described in Section 1.2.2.

2.2 Reasonable and Prudent Measures

NOAA Fisheries believes that the following RPMs are necessary and appropriate to minimize take of the above species. The USACE included EWEB's conservation measures in its proposed action that will reduce the amount of take associated with this project. These RPMs and the Terms and Conditions in Section 2.3 reflect the content of USACE's conservation measures, but provide additional detail and include project-specific conditions to minimize take. The USACE shall include permit provisions to ensure that EWEB shall:

1. Minimize the likelihood of incidental take associated with in-stream work by restricting in-water work to the in-water work period recommended by ODFW.

2. Minimize the likelihood of incidental take by ensuring that fish passage (both upstream and downstream) is provided in the project area both during and after construction of this project.

3. Minimize the likelihood of incidental take associated with fish salvage/capture and release during dewatering by implementing the guidelines in NMFS (2002) to avoid or minimize fish injury and mortality.

4. Minimize the likelihood of incidental take and alteration of habitat associated with construction-related erosion and chemical contamination by ensuring that effective pollution and erosion control measures are developed and implemented.

5. Minimize the likelihood of incidental take and alteration of habitat from general construction practices by ensuring that construction practices are designed to limit the affected area to the minimum necessary to complete the project, by implementing responsible construction techniques, and by proper site restoration.

6. Monitor the effectiveness of the proposed conservation measures in minimizing incidental take and report the results to NOAA Fisheries.

7. Minimize the likelihood of incidental take resulting from improperly-functioning fish passage facilities by developing and implementing a plan to inspect and maintain the new fish ladder.

2.3 Terms and Conditions

1. To implement RPM #1 (in-water work), USACE shall include permit provisions to ensure that:
    a. Wherever possible, work within the active channel of all anadromous fish-bearing

streams, or in systems, which could potentially contribute, sediment or toxicants to downstream fish-bearing systems, will be completed within the ODFW approved in-water work period. Due to the length of time necessary to complete some of the facilities, some in-water construction will occur outside the in-water work guidelines, based on the schedule in Appendix A of the Join Biological opinion (Appendix C) that was developed in consultation with ODFW specifically for construction at the Leaburg and Walterville projects and which was approved previously by NOAA Fisheries, USFWS and FERC.

b. If EWEB needs to extend the in-water work period from those identified in Attachment A of the Joint biological opinion (Appendix C), including those for work outside the wetted perimeter of the stream, but below the ordinary high water mark, the extensions must be approved by biologists from the Services.

2. To implement RPM #2 (fish passage), USACE shall include permit provisions to ensure that:

   a. Work will not inhibit passage of any adult or juvenile salmonid species throughout the construction period or after project completion. All culvert and road designs will comply with ODFW guidelines and criteria for stream-road crossings with appropriate grade controls to prevent culvert failure due to changes in stream elevation. EWEB's construction activities will not modify channels that could adversely affect fish passage, such as by increasing water velocities.

3. To implement RPM #3 (fish capture and release), USACE shall ensure that:

   a. Any water intake structure must have a fish screen installed, operated and maintained in accordance to NOAA Fisheries' fish screen criteria.

   b. Seine and release. Prior to and intermittently during pumping, EWEB will attempt to seine and release fish from the work isolation area as is prudent to minimize risk of injury.

      i. Seining will be conducted by or under the supervision of EWEB's fishery biologist and all staff working with the seining operation will have the necessary knowledge, skills, and abilities to ensure the safe handling of all ESA-listed fish.

      ii. ESA-listed fish will be handled with extreme care and kept in water to the maximum extent possible during seining and transfer procedures. Any transfer of ESA-listed fish will be conducted using a sanctuary net that holds water during transfer, whenever necessary to prevent the added stress of an out-of-water transfer.

      iii. Seined fish will be released as near as possible to capture sites. If EWEB transfers any ESA-listed fish to third-parties other than the Services personnel, EWEB will secure written approval from the Services.

      iv. EWEB will obtain any other Federal, state, and local permits and authorizations necessary for the conduct of the seining activities.

v. EWEB will allow the Services or their designated representatives to accompany field personnel during the seining activity, and allow such representative to inspect EWEB's seining records and facilities.

vi. A description of any seine and release effort will be included in a post-project report.

4. To implement RPM #4 (pollution and erosion control), USACE shall ensure that:

   a. Pollution and Erosion Control Plan. A PECP will be developed for each authorized project to prevent point-source pollution related to construction operations. For the Leaburg and Walterville construction activities, EWEB is required to develop and submit for FERC approval a PECP for construction and operation as described in License Article 401. In addition to meeting the license article requirements, EWEB ensures the PECP will contain the pertinent elements listed below and meet requirements of all applicable laws and regulations:

      i. Methods that will be used to prevent erosion and sedimentation associated with access roads, stream crossings, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations and staging areas.

      ii. Methods that will be used to confine and remove and dispose of excess concrete, cement and other mortars or bonding agents, including measures for washout facilities.

      iii. A description of the hazardous products or materials that will be used, including inventory, storage, handling, and monitoring.

      iv. A Spill Containment and Control Plan with notification procedures, specific clean up and disposal instructions for different products, quick response containment and clean up measures that will be available on site, proposed methods for disposal of spilled materials, and employee training for spill containment.

   b. Measures that will be taken to prevent construction debris from falling into any aquatic habitat. Any material that falls into a stream during construction operations will be removed in a manner that has a minimum impact on the streambed and water quality.

5. To implement RPM #5 (responsible construction practices), USACE shall ensure that:

   a. Sediment-laden or contaminated water pumped from the work isolation area will be discharged into an upland area where practicable providing over-ground flow prior to returning to the canal or river. Discharge will occur in such a manner as not to cause erosion. For areas where no upland area is present EWEB will assure the discharge is filtered prior to being returned to the river and filtered material is not released back to the river upon removal. EWEB will not discharge into potential fish spawning areas or areas with submerged vegetation.

   b. Temporary access roads. EWEB will design temporary access roads as follows:

i. Existing roadways or travel paths will be used whenever reasonable.
ii. A helicopter survey conducted with ODFW during the 2001 spawning season located spawning habitat. Where stream crossings are essential, EWEB will avoid any spawning habitat within 1,000 ft upstream and downstream.
iii. No stream crossings will occur at known or suspected spawning areas or within 300 ft upstream of such areas where impacts to spawning areas may occur.
iv. Where stream crossings are essential, EWEB's crossing design will accommodate reasonably foreseeable risks (e.g. flooding and associated bedload and debris) to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.
v. EWEB vehicles and machinery will cross riparian areas and streams at right angles to maintain the main channel wherever reasonable.
vi. EWEB's temporary roads within 150 ft of streams will avoid, minimize and mitigate soil disturbance and compaction by clearing vegetation to ground level and placing clean gravel over geotextile fabric.
vii. EWEB will minimize the number of stream crossings.

c. Treated wood removal. EWEB will use the following precautions regarding removal of treated wood.
i. No treated wood debris will fall into the water. If treated wood debris does fall into the water, it will be removed immediately.
ii. All treated wood debris will be disposed of at an approved disposal facility for treated wood.
iii. If treated wood pilings will be removed, EWEB will ensure these conditions are followed:
iv. Pilings to be removed will be dislodged with a vibratory hammer, or other means acceptable to the Services.
v. Once loose, the pilings will be placed onto the construction barge or other appropriate dry storage location, and not left in the water or piled onto the stream bank.
vi. If pilings break during removal, the remainder of the submerged section will be left in place.
vii. Long- term disposal of the piles must be at an approved disposal area for hazardous materials of this classification.
viii. Projects involving pile removal require long-term monitoring to ensure that if altered currents expose more pile, it must also be removed.

d. Cessation of work. EWEB will cease all project operations, except efforts to minimize storm or high flow erosion, under high flow conditions that may result in inundation of the project area.

e. Wastewater filtering. Sediment-laden or contaminated water pumped from the work isolation area will be discharged into an upland area where practicable providing over-ground flow prior to returning to the canal or river. Discharge will occur in such a manner as not to cause erosion. For areas where no upland area is present, e.g. the right bank fish ladder, EWEB will assure the discharge is filtered prior to being returned to the river and filtered material is not released back to the river upon removal. EWEB will not discharge into potential fish spawning areas or areas with submerged vegetation.

f. Pre-construction activities. EWEB will undertake the following actions prior to significant alteration of the action area.
   - i. Boundaries of the clearing limits associated with site access and construction will be flagged to prevent ground disturbance of critical riparian vegetation, wetlands and other sensitive sites beyond the flagged boundary.
   - ii. The following erosion control materials will be onsite.
   - iii. A supply of erosion control materials (e.g., silt fence and straw bales) will be on hand to respond to sediment emergencies. Sterile straw or hay bales will be used when available to prevent introduction of weeds.
   - iv. An oil absorbing, floating boom will be available on-site during all phases of construction whenever surface water is present.
   - v. All temporary erosion controls (e.g., straw bales, silt fences) will be in-place and appropriately installed downslope of project activities within the riparian area. Effective erosion control measures will be in-place at all times during the contract, and will remain and be maintained until such time that permanent erosion control measures are effective.
   - vi. Heavy Equipment. EWEB will restrict use of heavy equipment as follows.
   - vii. When heavy equipment is required, EWEB will use equipment having the least impact (e.g., minimally sized, rubber tired).
   - viii. Heavy equipment will be fueled, maintained and stored as follows.
     - (1) All equipment that is used for instream work will be cleaned prior to operations below the bankfull elevation. External oil and grease will be removed, along with dirt and mud. No untreated wash and rinse water will be discharged into streams and rivers without adequate treatment.
     - (2) Place vehicle staging, maintenance, refueling, and fuel storage areas a minimum of 50 ft horizontal distance from Leaburg Canal and the McKenzie River for construction of Leaburg Tailrace Barrier. The PECP developed under Section a.iv. will prevent point-source pollution of the river.
     - (3) All vehicles operated within 150 ft of any stream or water body will be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected will be repaired before the vehicle resumes operation.

(4) When not in use, vehicles will be stored in the vehicle staging area.

g. Site preparation. EWEB will prepare the site in the following manner, including removal of stream materials, topsoil, surface vegetation and major root systems.
   i. To the extent practicable, any instream large wood or riparian vegetation that is moved or altered during construction will stay on site or be replaced with a functional equivalent.
   ii. EWEB will minimize clearing and grubbing within 150 ft of any stream occupied by listed salmonids during any part of the year, or within 50 ft of any stream not occupied by listed salmonids.
   iii. Tree removal will be strictly limited.
   iv. All perennial and intermittent streams: Trees (3 inches diameter at breast height or greater) will be removed from within 150 ft horizontal distance of the ordinary high water mark only when necessary for construction of approved facilities. All trees that will be removed will be flagged.
   v. Tree removal will be mitigated for onsite by a 2:1 replanting ratio.
   vi. Whenever the project area is to be revegetated or restored, EWEB will stockpile native channel material, topsoil and native vegetation removed for the project for redistribution on the project area.

h. Earthwork. EWEB will complete earthwork, including drilling, blasting, excavation, dredging, filling and compacting, in the following manner:
   i. Boulders, rock, woody materials and other natural construction materials used for the project will be obtained from outside of the riparian area.
   ii. During excavation, native streambed materials will be stockpiled above the bankfull elevation for later use. If riprap is placed, native materials will be placed over the top of the riprap.
   iii. Material removed during excavation will only be placed in locations where it cannot enter streams or other water bodies.
   iv. All exposed or disturbed areas will be stabilized to prevent erosion.
   v. Areas of bare soil within 150 ft of waterways, wetlands or other sensitive areas will be stabilized by native seeding,[5] mulching, and placement of erosion control blankets and mats, if applicable, quickly as reasonable after exposure, but within 7 days of exposure.
   vi. All other areas will be stabilized quickly as reasonable, but within 14 days of exposure.
   vii. Seeding outside of the growing season will not be considered adequate nor permanent stabilization.
   viii. All erosion control devices will be inspected during construction to ensure that they are working adequately.
   ix. Erosion control devices will be inspected daily during the rainy season, weekly during the dry season, monthly on inactive sites.

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[5]By Executive Order 13112 (02/03/99), Federal agencies are not authorized to permit, fund or carry out actions that are likely to cause, or promote, the introduction or spread of invasive species. Therefore, only native vegetation indigenous to the project vicinity, or region of the state where the project is located, shall be used.

x. If inspection shows that the erosion controls are ineffective, work crews will be mobilized immediately, during working and off-hours, to make repairs, install replacements, or install additional controls as necessary.

xi. Erosion control measures will be judged ineffective when turbidity plumes are evident in waters occupied by listed salmonids during any part of the year.

xii. If soil erosion and sediment resulting from construction activities is not effectively controlled, EWEB will limit the amount of disturbed area to that which can be adequately controlled.

xiii. Sediment will be removed from sediment controls once it has reached 1/3 of the exposed height of the control. Whenever straw bales are used, they will be staked and dug into the ground 5 inches (12 cm). Catch basins will be maintained so that no more than 6 inches (15 cm) of sediment depth accumulates within traps or sumps.

xiv. Sediment-laden water created by construction activity will be filtered before it enters a stream or other water body. Silt fences or other detention methods will be installed as close as reasonable to culvert outlets to reduce the amount of sediment entering aquatic systems.

i. Site restoration. EWEB will restore and clean up the site, including protection of bare earth by seeding, planting, mulching and fertilizing, in the following manner.

i. All damaged areas will be restored to pre-work conditions including restoration of original streambank lines, and contours.

ii. All exposed soil surfaces, including construction access roads and associated staging areas, will be stabilized at finished grade with mulch, native herbaceous seeding, and native woody vegetation prior to October 1. On cut slopes steeper than 1:2, a tackified seed mulch will be used so that the seed does not wash away before germination and rooting occurs. In steep locations, a hydro-mulch will be applied at 1.5 times the normal rate. Disturbed areas will be planted with native vegetation specific to the project vicinity or the region of the state where the project is located, and will comprise a diverse assemblage of woody and herbaceous species.

iii. Plantings will be arranged randomly within the revegetation area.

iv. All plantings will be completed prior to April 15.

v. No herbicide application will occur within 300 ft of any stream channel as part of this permitted action. Undesired vegetation and root nodes will be mechanically removed.No surface application of fertilizer will be used within 50 ft of any stream channel.

vi. Fencing will be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons.

vii. Plantings will achieve an 80% survival success after three years.

viii. If success standard has not been achieved after 3 years, EWEB will submit an alternative plan to the USACE). The alternative plan will address temporal loss of function.

ix. Plant establishment monitoring will continue and plans will be submitted to USACE until site restoration success has been achieved.

6. To implement RPM #6 (monitoring and reporting) USACE shall ensure that:
   a. Additional EWEB monitoring. EWEB will have a full-time inspector in the field monitoring construction practices, including compliance with EWEB's Proposed Measures and the PECP. Implementation of the FERC-required QCIP is designed to ensure environmental compliance quality control. The QCIP requires monthly progress reports regarding quality control of environmental protection measures, including the following: discussion of erosion control and other measures and their effectiveness, discussion of any instances where sediments or other construction discharges entered the stream, the extent of the discharges, an assessment of any damage to the stream, and corrective actions taken, including measures to prevent further problems. EWEB will also perform periodic, random site visits throughout the work period, accompanying the full-time inspector on site inspections and ensuring thorough inspection and enforcement of environmental measures. EWEB will send email summary reports of these visits to NMFS.
   b. Monitoring: Construction. Within 30 days of completing the project, EWEB will submit a monitoring report to USACE, ODSL, and the Services describing EWEB's success in carrying out the Proposed Measures to avoid, minimize, and mitigate for construction-related impacts. This report will consist of the following information.
      i. Project identification.
         (1) applicant's name;
         (2) project name;
         (3) construction activity;
         (4) compensatory mitigation site(s) (if any) by 5th field HUC and latilong;
         (5) starting and ending dates for work performed; and
         (6) EWEB's contact person.
      ii. Isolation of in-water work area. All projects involving isolation of in-water work areas will include a report of any seine and release activity including:
         (1) The name and address of the supervisory fish biologist;
         (2) methods used to isolate the work area and minimize disturbances to ESA-listed species;
         (3) stream conditions prior to and following placement and removal of barriers;
         (4) the means of fish removal;
         (5) the number of fish removed by species;
         (6) the location and condition of all fish released; and any incidence of observed injury or mortality.
      iii. Pollution and erosion control. Copies of all pollution and erosion control

inspection reports, including descriptions of any failures experienced with erosion control measures, efforts made to correct them and a description of any accidental spills of hazardous materials will be submitted.

iv. Treated wood pilings. Any project involving removal of treated wood pilings will include the name and address of the approved disposal area and the plan for long-term monitoring to ensure that if altered currents expose more pile, it will also be removed.

v. Site restoration. Documentation of the following conditions:

vi. Finished grade slopes and elevations.

vii. Log and rock structure elevations, orientation, and anchoring, if any.
   (1) Planting composition and density.
   (2) A plan to inspect and, if necessary, replace failed plantings and structures for a period of five years.
   (3) A narrative assessment of the project's effects on natural stream function.

viii. Photographic documentation of environmental conditions at the project site and compensatory mitigation site(s) (if any) before, during and after project completion.
   (1) Photographs will include general project location views and close-ups showing details of the project area and project, including pre and post construction.
   (2) Each photograph will be labeled with the date, time, photo point, project name, the name of the photographer, and a comment describing the photograph's subject.
   (3) Relevant habitat conditions include characteristics of channels, streambanks, riparian vegetation, flows, water quality, and other visually discernable environmental conditions at the project area, and upstream and downstream of the project.

7. To implement RPM #7 (fish passage facility maintenance), USACE shall ensure that:
   a. EWEB shall prepare and implement plans for monitoring and maintenance of the fishways and to prepare and implement plans to conduct post-installation hydraulic and biological evaluations. These plans shall be prepared in cooperation with USFWS, ODFW, NOAA Fisheries, and subsequently subject to the approval of NOAA and USFWS.

3. Essential Fish Habitat

Public Law 104-267, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to establish new requirements for "Essential Fish Habitat" (EFH) descriptions in Federal fishery management plans and to require Federal agencies to consult with NMFS on activities that may adversely affect EFH. Essential Fish Habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" Magnuson-Stevens Act §3. The Pacific Fisheries Management Council (PFMC) has designated EFH for Federally-managed groundfish and coastal pelagics fisheries. The Council has also recommended an EFH designation for the Pacific salmon fishery. EFH includes those waters and substrate necessary to ensure the production needed to support a long-term sustainable fishery (i.e., properly functioning habitat conditions necessary for the long-term survival of the species through the full range of environmental variation).

The Magnuson-Stevens Act requires consultation for all actions that may adversely affect EFH, and it does not distinguish between actions in EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities that may have an adverse effect on EFH. Therefore, EFH consultation with NOAA Fisheries is required by Federal agencies undertaking, permitting, or funding activities that may adversely affect EFH, regardless of its location.

The consultation requirements of section 305(b) of the Magnuson-Stevens Act (16 U.S.C. 1855(b)) provide that:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH.
- NOAA Fisheries shall provide conservation recommendations for any Federal or State activity that may adversely affect EFH.
- Federal agencies shall within 30 days after receiving conservation recommendations from NOAA Fisheries provide a detailed response in writing to NOAA Fisheries regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NOAA Fisheries, the Federal agency shall explain its reasons for not following the recommendations.

3.1 Identification of Essential Fish Habitat

The Columbia River estuary and the Pacific Ocean off the mouth of the Columbia River are designated as EFH for groundfish and coastal pelagic species. The marine extent of groundfish and coastal pelagic EFH includes those waters from the nearshore and tidal submerged environments within Washington, Oregon, and California state territorial waters out to the exclusive economic zone (370.4 km) offshore between the Canadian border to the north and the

Mexican border to the south.

The proposed salmon EFH includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except above the impassable barriers identified by PFMC. Big Cliff, Cougar, Dexter, and Dorena dams are the listed manmade barriers that represent the upstream extent of the proposed chinook salmon EFH in the Willamette basin. Habitat above Foster and Fall Creek dams is included in proposed chinook salmon EFH because they had fish passage at the time of EFH designation. Detroit, Green Peter, Blue River, Lookout Point, Hills Creek, Cottage Grove, and Fern Ridge dams do not appear on the list of dams marking the upstream extent of proposed chinook salmon EFH because these dams did not block this species at the time of proposed EFH designation due to being upstream of its' range. Proposed salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). In the estuarine and marine areas, proposed salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border.

3.2 Proposed Action

The proposed action in this biological opinion is the issuance of a 404 permit for dredge and fill activities associated with the construction of the Leaburg Tailrace Barrier. EWEB and USACE propose that this project include construction and removal of cofferdams, construction of the tailrace barrier, modification to the existing Leaburg fish screens (including new concrete wing walls, relocation of existing pumps and piping, and regrading the right bank of Leaburg Canal), and dewatering of portions of Leaburg Canal.

Estuarine and offshore marine waters are designated EFH for various life stages of 62 species of groundfish and five coastal pelagic species. A detailed description and identification of EFH for groundfish is found in the Final Environmental Assessment/Regulatory Impact Review for Amendment 11 to The Pacific Coast Groundfish Management Plan and the NMFS Essential Fish Habitat for West Coast Groundfish Appendix. A detailed description and identification of EFH for coastal pelagic species is found in Amendment 8 to the Coastal Pelagic Species Fishery Management Plan. The proposed action area also encompasses the Council-designated EFH for chinook (*Onchorhynchus tshawytscha*) and for coho (*Onchorhynchus kisutch*) salmon. A description and identification of EFH for salmon is found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan. Assessment of the impacts to these species' EFH from the above proposed FERC action is based on this information.

The objective of this EFH consultation is to determine whether the proposed action without further EFH consultation may adversely affect EFH for the species listed in Table 3 below and for the listed chinook salmon within the action area. Another objective of this EFH consultation is to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse impacts to EFH resulting from the proposed action.

3.3 Effects of the Proposed Action

The effects of the proposed action on UWR chinook salmon and its habitat within the action area are described above. Coho hatchery fish released in this basin were not successful in building a self sustaining population (pers. comm. Tim Downey, June 19, 2003, EWEB, Eugene, Or.). Therefore, coho salmon are not included in this EFH consultation. In addition, the proposed action is not likely to affect EFH of any of the other species listed in Table 3.

3.4 Conclusion

NMFS believes that the proposed action may adversely affect designated EFH for listed UWR chinook salmon.

3.5 EFH Conservation Recommendations

The Incidental Take Statement in Chapter 2 provides non-discretionary RPMs and Terms and Conditions that are applicable to designated EFH for UWR chinook salmon. Therefore, NMFS recommends that the RPMs and Terms and Conditions listed above be adopted. Should these EFH conservation recommendations be adopted, potential adverse impacts to EFH would be minimized from this proposed action.

3.6 Statutory Requirements

The Magnuson-Stevens Act and Federal regulations (50 CFR Section 600.920) to implement the EFH provisions require Federal action agencies to provide a written response to EFH Conservation Recommendations within 30 days of receipt. The final response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity. If the response is inconsistent with the EFH Conservation Recommendations, an explanation of the reasons for not implementing them must be included.

3.7 Consultation Renewal

FERC must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR Section 600.920).

Table 3. Species with designated EFH found in waters of the State of Oregon.

Ground Fish Species	Blue rockfish (*S. mystinus*)	Rougheye rockfish (*S. aleutianus*)	Flathead sole (*Hippoglossoides elassodon*)
Leopard shark (*Triakis semifasciata*)	Bocaccio (*S. paucispinis*)	Sharpchin rockfish (*S. zacentrus*)	Pacific sanddab (*Citharichthys sordidus*)
Soupfin shark (*Galeorhinus zyopterus*)	Brown rockfish (*S. auriculatus*)	Shortbelly rockfish (*S. jordani*)	Petrale sole (*Eopsetta jordani*)
Spiny dogfish (*Squalus acanthias*)	Canary rockfish (*S. pinniger*)	Shortraker rockfish (*S. borealis*)	Rex sole (*Glyptocephalus zachirus*)
Big skate (*Raja binoculata*)	Chilipepper (*S. goodei*)	Silvergray rockfish (*S. brevispinus*)	Rock sole (*Lepidopsetta bilineata*)
California skate (*R. inornata*)	China rockfish (*S. nebulosus*)	Speckled rockfish (*S. ovalis*)	Sand sole (*Psettichthys melanostictus*)
Longnose skate (*R. rhina*)	Copper rockfish (*S. caurinus*)	Splitnose rockfish (*S. diploproa*)	Starry flounder (*Platyichthys stellatus*)
Ratfish (*Hydrolagus colliei*)	Darkblotched rockfish (*S. crameri*)	Stripetail rockfish (*S. saxicola*)	
Pacific rattail (*Coryphaenoides acrolepsis*)	Grass rockfish (*S. rastrelliger*)	Tiger rockfish (*S. nigrocinctus*)	**Coastal Pelagic Species**
Lingcod (*Ophiodon elongatus*)	Greenspotted rockfish (*S. chlorostictus*)	Vermillion rockfish (*S. miniatus*)	Northern anchovy (*Engraulis mordax*)
Cabezon (*Scorpaenichthys marmoratus*)	Greenstriped rockfish (*S. elongatus*)	Widow Rockfish (*S. entomelas*)	Pacific sardine (*Sardinops sagax*)
Kelp greenling (*Hexagrammos decagrammus*)	Longspine thornyhead (*Sebastolobus altivelis*)	Yelloweye rockfish (*S. ruberrimus*)	Pacific mackerel (*Scomber japonicus*)
Pacific cod (*Gadus macrocephalus*)	Shortspine thornyhead (*Sebastolobus alascanus*)	Yellowmouth rockfish (*S. reedi*)	Jack mackerel (*Trachurus symmetricus*)
Pacific whiting (Hake) (*Merluccius productus*)	Pacific Ocean perch (*S. alutus*)	Yellowtail rockfish (*S. flavidus*)	Market squid (*Loligo opalescens*)
Sablefish (*Anoplopoma fimbria*)	Quillback rockfish (*S. maliger*)	Arrowtooth flounder (*Atheresthes stomias*)	
Aurora rockfish (*Sebastes aurora*)	Redbanded rockfish (*S. babcocki*)	Butter sole (*Isopsetta isolepsis*)	**Salmon**
Bank Rockfish (*S. rufus*)	Redstripe rockfish (*S. proriger*)	Curlfin sole (*Pleuronichthys decurrens*)	Coho salmon (*O. kisutch*)
Black rockfish (*S. melanops*)	Rosethorn rockfish (*S . helvomaculatus*)	Dover sole (*Microstomus pacificus*)	Chinook salmon (*O. tshawytscha*)
Blackgill rockfish (*S. melanostomus*)	Rosy rockfish (*S. rosaceus*)	English sole (*Parophrys vetulus*)	

4. LITERATURE CITED

Arkoosh, M. R., E. Casillas, E. Clemons, A. N. Kagley, R. Olson, P. Reno, and J. E. Stein. 1998a. Effect of pollution on fish diseases: potential impacts on salmonid populations. Journal of Aquatic Animal Health 10:182-190.

Arkoosh, M. R., E. Casillas, P. Huffman, E. Clemons, J. Evered, J. E. Stein, and U. Varanasi. 1998b. Increased susceptibility of juvenile chinook salmon from a contaminated estuary to *Vibrio anguillarum*. Transactions of the American Fisheries Society 127: 360-374.

Bell, M. C. 1991. Fisheries handbook of engineering requirements and biological criteria. Fish Passage Development and Evaluation Program. U. S. Army Corps of Engineers. North Pacific Division.

Berg, L. and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Birtwell, I. K., G. F. Hartman, B. Anderson, D. J. McLeay, and J. G. Malick. 1984. A brief investigation of arctic grayling (*Thymallus arcticus*) and aquatic invertebrates in the Minto Creek drainage, Mayo, Yukon Territory: An area subjected to placer mining. Canadian Technical Report of Fisheries and Aquatic Sciences 1287.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 *in* W. R. Meehan, ed. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19:83-138.

BLME (Bureau of Land Management, Eugene District). 1995. Mohawk River Watershed Analysis.

BLME (Bureau of Land Management, Eugene District). 1996. Vida/McKenzie River Watershed Analysis.

BLME (Bureau of Land Management, Eugene District). 1998. Bear and Marten Creeks Watershed Analysis.

BPA (Bonneville Power Administration). 1985. Wildlife & wildlife habitat loss assessment summary at federal hydroelectric facilities in the Willamette River Basin (by Noyes J. H. and M. S. Potter). U.S. Dept. of Energy, BPA (Environment, Fish, and Wildlife), Portland, Oregon.

Craig, J.A. and L. D. Townsend. 1946. An investigation of fish-maintenance problems in relation to the Willamette Valley Project. U.S. Fish and Wildlife Service. Special Scientific Report No. 33.

DeVore, P. W., L. T. Brooke, and W. A. Swenson. 1980. The Effects of Red Clay Turbidity and Sedimentation on Aquatic Life In the Nemadji River System. Impact of Nonpoint Pollution Control on Western Lake Superior. EPA Report 905/9-79-002-B. U.S. Environmental Protection Agency, Washington, D.C.

Downey, T. 2003. E-Mail to Melissa Jundt, NOAA Fisheries, from Tim Downey, EWEB, Re: information for the Leaburg Opinion and Article 416 plan. This e-mail addressed anticipated take of listed species during salvage operations.

EA (EA Engineering, Science, and Technology). 1991a. The fluvial geomorphology of the lower McKenzie River. Report prepared for Eugene Water and Electric Board, 12 p. plus appendix.

EA. 1991b. Evaluation of riparian vegetation along the lower McKenzie River. Report prepared for Eugene Water and Electric Board.

EA. 1991c. Entrainment studies at the Walterville Hydroelectric Project. Report prepared for Eugene Water and Electric Board.

EA. 1991d. Radio-tracking studies of adult spring chinook salmon migration behavior in the McKenzie River, Oregon. Report prepared for Eugene Water and Electric Board. EA Engnieering Services and Technology, Lafayette, Ca.

EWEB (Eugene Water & Electric Board). 1995. White paper on water quality. Prepared by the Eugene Water and Electric Board, relating to the Leaburg-Walterville Hydroelectric Project. July 14, 1999. Eugene Water and Electric Board, Eugene, Oregon.

EWEB. 2002. Fish salvage plan for Walterville Canal and Tailrace prior to dewatering for major construction 2002, Article 422. April.

EWEB. 2003. Biological Assessment of the effects due to 404 permit issuance for construction of FERC-approved structures at the Leaburg fish screen and Leaburg tailrace, Leaburg-Walterville Hydroelectric Project. Draft; June 10, 2003.

FERC (Federal Energy Regulatory Commission). 1996. Final Environmental Impact Statement of the Leaburg-Walterville Hydroelectric Project (FERC Project No. 2496), Oregon. Federal Energy Regulatory Commission, Office of Hydropower Licensing, Washington, D.C. FERC/EIS-094.

FERC. 2001. Biological Assessment for the Eugene Water and Electric Board's McKenzie

River Hydroelectric Projects. Issued by FERC on February 14, 2001.

Grant, G., S. Lewis, and P. Kast. 2002. Sediment mass balance for Cougar Reservoir sediment releases, Supplement to "Evaluation of fine sediment intrusion into Salmon Spawning Gravels are related to Cougar reservoir sediment releases." Prepared for U.S. Army Corps of Engineers, Portland district, Portland, Or. November 5.

Gregory, R. S. 1993. Effect of turbidity on the predator avoidance behavior of juvenile chinook salmon (*Oncorhynchus tshawytcha*). Canadian Journal of Fisheries and Aquatic Sciences 50:241-246.

Gregory, R. S., and C. D. Levings. 1998. Turbidity Reduces Predation on Migrating Juvenile Pacific Salmon. Transactions of the American Fisheries Society 127: 275-285.

Grimes, J.T., R.B. Lindsay, K.R. Kenaston, K. Homolka and R.K. Schroeder. 1996. Willamette Spring Chinook. Oregon Department of Fish and Wildlife, Fish Research Report F-163-R-00, Annual Progress Report, Portland.

Homolka, K. And T. Downey. 1995. Information Reports Number 95-4. Assessment of Thermal Effects on Salmon Spawning and Fry Emergence, Upper McKenzie River, 1992.

Jossis, R. 2003. E-mail. To: Melissa Jundt, From: Robert Jossis, Montgomery Watson Harza (on behalf of EWEB), Re: effects questions raised during review. June 19.

Ligon, F. K., W. E. Dietrich, and W. J. Trush. 1995. Downstream ecological effects of dams: A geomorphic perspective. Bioscience 45:183-192.

Lindsay, R.B., K.R. Kenaston, R.K. Schroeder, J.T. Grimes, M. Wade, K. Homolka, and L. Borgerson. 1997. Spring chinook salmon in the Willamette and Sandy rivers. Oregon Department of Fish and Wildlife, Fish Research Report F-163-R-01, Annual Progress Report, Portland.

Lloyd, D. S. 1987. Turbidity as a water quality standard for salmonid habitats in Alaska. North American Journal of Fisheries Management 7:34-45.

Lloyd, D. S., J. P. Koenings, and J. D. LaPerriere. 1987. Effects of Turbidity in Fresh Waters of Alaska. North American Journal of Fisheries Management 7:18-33.

Mattson, C. R. 1948. Spawning ground studies of Willamette River spring chinook salmon. Research Briefs of the Oregon Fish Commission, 1(2):21-32.

Mattson, C.R. 1962. Early life history of Willamette River spring chinook salmon. Oregon Fish Commission. Portland, Oregon.

Mattson, C.R. 1963. An investigation of adult spring chinook salmon of the Willamette River system. Oregon Fish Commission, Portland, Oregon.

McClure, M. M., B. Sanderson, E. Holmes, C. Jordan, P. Kareiva, and P. Levin. 2000. Revised Appendix B of standardized quantitative analysis of the risks faced by salmonids in the Columbia River basin. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. September.

McElhany, P., M. Ruckelshaus, M.J. Ford, T. Wainwright, and E. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. January 6.

McKernan, D.L. and C.R. Mattson. 1950. Observations on pulp and paper effluents and the probable effects of this pollutant on the fisheries resources of the Willamette River in Oregon. Fish Commission Research Briefs. Fish Commission of Oregon. Volume 3(1):14-21.

McLeay, D. J., G. L. Ennis, I. K. Birtwell, and G. F. Hartman. 1984. Effects On Arctic Grayling (*Thymallus arcticus*) of Prolonged Exposure to Yukon Placer Mining Sediment: A Laboratory Study. Canadian Technical Report of Fisheries and Aquatic Sciences 1241.

Minear, P.J. 1994. Historical change in channel form and riparian vegetation of the McKenzie River, Oregon. M.S. thesis, Oregon State University, Corvallis, Oregon.

Monk, M.H., E. Dawley, and K. Beiningen. 1975. Concentration of dissolved gases in the Willamette, Cowlitz, and Boise Rivers, 1970-72. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Seattle, Wa. June 1975.

Myers, J. M., R. G. Kope, G. J. Bryant, L. J. Lierheimer, R. S. Waples, R. W. Waknitz, T. C. Wainwright, W. S. Grant, K. Neely, and S. T. Lindley. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. National Marine Fisheries Service, Northwest Fisheries Science Center, NOAA Technical Memorandum NMFS-NWFSC-35, Seattle, Washington.

Naimen, R.J. and H. Decamps. 1997. The Ecology of Interfaces: Riparian Zones. University of Washington, School of Fisheries. Seattle, Washington.

NMFS. 1995. National Marine Fisheries Service, Juvenile Fish Screen. National Marine Fisheries Service, Environmental & Technical Services Division. Portland, Oregon. February 16.

NMFS. 1996. Addendum: Juvenile Fish Screen Criteria for Pump Intakes (guidelines and criteria for migrant fish passage facilities, and new pump intakes and existing inadequate pump intake screens). National Marine Fisheries Service, Environmental and Technical Services Division. May 9.

NMFS (National Marine Fisheries Service). 1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. National Marine Fisheries Service, Environmental and Technical Services Division, Habitat Conservation Branch.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 2000. Biological Opinion on Effects of Cougar Reservoir Water Temperature Control Project on Upper Willamette River Chinook Salmon, its Critical Habitat, Bull Trout, Northern Spotted Owl, and its Critical Habitat. Signed March 8, 2000, by NMFS Habitat Conservation Division's Oregon State Branch and USFWS Oregon State Office, Portland, Oregon.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 2001. Biological Opinion on the Effects of Relicensing of EWEB's Leaburg-Walterville Hydroelectric Project in the McKenzie Subbasin, Oregon. Signed on September 6, 2001, by the Regional Administrator (acting) Donna Darm and USFWS Oregon State Office, Portland, Oregon.

Newcombe, C. P., and D. D. MacDonald. 1991. Effects of Suspended Sediments on Aquatic Ecosystems. North American Journal of Fisheries Management 11: 72-82.

NOAA Fisheries. 2002a. Effects of Issuing USACE Clean Water Act Section 404 permit #2002-00109 for Construction Activities at the Leaburg Dam Fish Ladders, McKenzie River, Oregon. NOAA Fisheries, Northwest Region, Hydropower Program. Portland, Or. May, 20.

NOAA Fisheries. 2002b. Effects of issuing Clean Water Act Section 404 Permit #2002-00155 for Construction Activities at the Walterville Project, McKenzie River, Or. NOAA Fisheries, Northwest Region, Hydropower Program, Portland, Or. June 21.

NOAA Fisheries. 2002c. Letter Re: Effects of elevated turbidity from water temperature control construction at Cougar Dam on Upper Willamette River Chinook Salmon, to George J. Miller, U.S. Army Corps of Engineers, Portland District, Portland, Or. July 10.

NOAA Fisheries. 2003. Letter Re: Final Approval of Leaburg-Walterville Project Improvements - Phase 2. To Gale Banry, Eugene Water & Electric Board, Eugene, Or. May 22.

ODEQ (Oregon Department of Environmental Quality). 2002. 2002 List of water quality limited waterbodies and Oregon's criteria for listing waterbodies. Oregon Department of Environmental Quality, Salem. URL: http://www.deq.state.or.us

ODFW (Oregon Department of Fish and Wildlife). 1996. Letter re: Unpublished data documentation; ODFW response to FERC's Section 10(j) Dispute Resolution Letter, February 23, 1996; Leaburg Walterville Hydroelectric Project, FERC No. 2496-006, to Ed Meyer, Federal Energy Regulatory Commission, Washington, D.C. March 13.

ODFW. 1998a. Spring chinook chapters – Willamette basin fish management plan. Oregon Department of Fish and Wildlife, Portland. March.

ODFW. 1998b. Memorandum re: harvest rates for Willamette spring chinook, to J. Martin from S. Sharr, Oregon Department of Fish and Wildlife, Portland. September 30.

ODFW. 1999a. Guidelines and criteria for stream road crossings, in: G. E. Robison, A. Mirati, and M. Allen, Oregon Road/Stream Crossing Restoration Guide. Oregon Department of Fish and Wildlife. Portland, Or. Spring.

ODFW. 1999b. November 16, 1999,13 page fax of aerial redd count data in McKenzie River from 1995-1997 from Mark Wade, ODFW Springfield, to Lance Smith, NMFS Portland.

ODFW. 2000. Guidelines for Timing of In-Water Work to protect Fish and Wildlife Resources. Oregon Department of Fish and Wildlife. June 2000.

ODFW. 2001. Fisheries management and evaluation plan for Upper Willamette River winter wteelhead in sport fisheries of the upper Willamette basin. Oregon Department of Fish and Wildlife, Salem. June 8.

Parkhurst, Z.E., F.G. Bryant, and R.S. Nielson. 1950. Survey of the Columbia River and its tributaries. Part 3. Special Scientific Report – Fisheries, No. 36.

Pogue and Anderson. 1995. Process Controlling Dissolved Oxygen and pH in the Upper Willamette River Basin, Oregon, 1994. U.S. Geological Survey.

Redding, J. M., C. B. Schreck, and F. H. Everest. 1987. Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids. Transactions of the American Fisheries Society 116: 737-744.

Scannell, P. O. 1988. Effects of Elevated Sediment Levels from Placer Mining on Survival and Behavior of Immature Arctic Grayling. Alaska Cooperative Fishery Unit, University of Alaska. Unit Contribution 27.

Sedell, J. R., B. A. MacIntosh, and P. Minear. 1992. Evaluation of past and present stream habitat conditions for the Army Corps of Engineers McKenzie River temperature control study. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Corvallis, Oregon.

Servizi, J. A., and Martens, D. W. 1991. Effects of Temperature, Season, and Fish Size on Acute Lethality of Suspended Sediments to Coho Salmon. Canadian Journal of Fisheries and Aquatic Sciences 49:1389-1395.

Sigler, J. W., T. C. Bjornn, and F. H. Everest. 1984. Effects of Chronic Turbidity on Density and Growth of Steelhead and Coho Salmon. Transactions of the American Fisheries Society 113:142-150.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki, 1996. An Ecosystem Approach to Salmonid Conservation. Mantech Environmental Research Services Corporation, Corvallis, Oregon.

Stockner, J. G., E. Rydin, and P. Hyenstrand. 2000. Cultural oligotrophication: Causes and consequences for fisheries resources. Fisheries 25(5):7-14.

Stewart, G., J. Glassman, G. Grant, S. Lewis, and J. Ninnerman. 2002. Evaluation of fine sediment intrusion into salmon spawning gravels as related to Cougar Reservoir sediment releases. Prepared for U.S. Army Corps of Engineers, Portland District, Portland, Or. October 4.

Triska, F. J., J. R. Sedell, K. Cromack, Jr., and F. M. McCorison. 1984. Nitrogen budget for a small coniferous forest stream. Ecological Monographs 54:119-140.

USACE (U.S. Army Corps of Engineers). 1995. Willamette River temperature control, McKenzie Subbasin, Oregon. Volume I, final feasibility report and environmental impact statement. U.S. Army Corps of Engineers, Portland District, Portland.

USACE (U.S. Army Corps of Engineers). 2000. Biological Assessment of the effects of the Willamette River Basin flood control project on species listed under the Endangered Species Act. Final; April 2000. USACE Portland District.

USACE (U.S. Army Corps of Engineers). 2003. Willamette Temperature Control, McKenzie River Subbasin, Oregon, Cougar Dam and Reservoir, Draft Supplemental Information Report. U.S. Army Corps of Engineers, Portland District. January 2003.

USFWS (U. S. Fish and Wildlife Service). 1948. Willamette Valley Project, Oregon. Preliminary evaluation report on fish and wildlife resources. U.S. Department of Interior, Portland, Oregon.

USFWS (U. S. Fish and Wildlife Service). 1959. Cougar Dam and Reservoir Project: A detailed report on the fish and wildlife resources. USFWS Region 1, Portland, Oregon.

USFWS (U. S. Fish and Wildlife Service). 1965. Blue River Dam and Reservoir Project: A detailed report on the fish and wildlife resources. Office of the Commissioner. Portland, Oregon.

USFWS (U.S. Fish & Wildlife Service). 1994. Fish and Wildlife Coordination Act report for the proposed McKenzie River Temperature Control Project. Oregon State Office, Portland.

USGS (U.S. Geological Survey). 1995. Analysis of nutrient and ancillary water quality data for surface and ground water of the Willamette Basin, Oregon, 1980-1990. By Bonn, B. A., S.R. Hinkle, D. A. Wentz, and M. A. Uhrich. USGS Water Resources Investigations Report 95-4036, Portland, Oregon.

USGS (U.S. Geological Survey). 1996. Willamette Basin, Oregon - Nitrogen in streams and ground water, 1980-1990. By Bonn, B. A., D. A. Wentz, and S. R. Hinkle. USGS Open-File Report 96-227, Portland, Oregon.

WNF (Willamette National Forest). 1992. Sweetwater Creek Bull Trout Passage Project. McKenzie Ranger District, Willamette National Forest, McKenzie Bridge, Oregon.

WNF (Willamette National Forest). 1995. Olallie Creek Bull Trout Passage Project. McKenzie Ranger District, Willamette National Forest, McKenzie Bridge, Oregon.

WNF BRRD (Willamette National Forest, Blue River Ranger District). 1994. South Fork McKenzie River Watershed Analysis.

WNF BRRD (Willamette National Forest, Blue River Ranger District). 1996. Blue River Watershed Analysis.

WNF BRRD (Willamette National Forest, Blue River Ranger District). 1998. Quartz Creek Watershed Analysis.

WNF MRD (Willamette National Forest, McKenzie Ranger District). 1995. Upper McKenzie River Watershed Analysis.

WNF MRD (Willamette National Forest, McKenzie Ranger District). 1997. Horse Creek Watershed Analysis.